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A GUIDE TO URINARY DISEASES

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172055.
18/6/22

LONDON

EDWARD ARNOLD & CO.

1921

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PREFACE

IN no branch of medicine more than in diseases of the urinary tract and disturbances of the act of micturition is greater difficulty experienced in the separation of medical from surgical conditions. For this reason the co-operation of physician and surgeon in the preparation of this small work requires no justification. The aim of the authors has been primarily to assist the general practitioner in identifying a lesion from the symptoms which are present. Only such pathological details are included as can be strictly regarded as essential to this end; and whilst elementary clinical pathology has not been neglected, only the barest reference has been made to those methods of investigation which demand the resources of a well-equipped laboratory and the technical skill of an experienced pathologist.

It has been thought unnecessary to elaborate certain methods of treatment, which only a surgical specialist could adequately undertake, but a more detailed description has been given of measures which are regarded as urgent, and which a practitioner would consider to come legitimately within his province.

A. A.

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LONDON, *September*, 1921.

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A GUIDE TO URINARY DISEASES

CHAPTER I

URINE: ITS NORMAL CHARACTERISTICS AND VARIATIONS

A BRIEF chapter upon the appearance and other characteristics of normal urine affords a convenient introduction to the study of pathological conditions of the urinary tract and of other systems which may lead to disturbances of micturition. In this way may first be emphasised the circumstance that considerable variations are compatible with health, and that even the existence of admittedly abnormal substances may be occasionally encountered in conditions which cannot strictly be termed disease.

Characteristically, healthy urine freshly voided has a clear limpid appearance, and remains so for hours. At a variable period after its excretion, a faint cloud of mucus gradually settles to the bottom of the specimen glass, the chief importance of which is that it should not be mistaken for tube casts and prostatic threads occurring in chronic gonorrhœa and gleet. In women, the mucus cloud is normally denser from admixture with vulval and vaginal secretion and epithelial scales. A general cloudiness present in freshly voided urine denotes as a rule the presence of pus or of bacteria, but such a turbidity may be due merely to the precipitation of phosphates in large quantity in an alkaline urine, as is easily shown by its complete disappearance

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when dilute acetic acid is added. Turbidity which appears on standing is only an indication of the presence of urates : such turbidity rapidly clears up on heating. On very rare occasions a cloudy appearance is due to the suspension of finely divided particles of fat, a condition known as chyluria. (See page 40.)

In considering appearance one naturally passes to the *colour* of urine. This is normally a faint amber yellow due to urochrome, and its intensity varies with concentration. Thus in summer, urine is generally darker, and the urine passed on rising is of a more intense yellow than that voided during the rest of the day. In fevers, also, the colour is dark, partly as the result of concentration and partly from excess of pigments. Very light-coloured urine results from the natural dilution consequent upon the imbibition of large quantities of fluid, and a light colour is similarly encountered in the urine of low specific gravity in diabetes insipidus and granular kidney. A very light dilute urine is sometimes passed after an hysterical seizure. But coloration alone is no certain indication of low specific gravity, for a very light-coloured urine is frequently seen in diabetes mellitus, containing a large quantity of sugar and of high specific gravity.

The colour of urine may be modified by the presence of pigments, some normally present in urine but in certain circumstances excreted in excessive quantity, others adventitiously introduced if certain drugs or foodstuffs have been taken. Thus beetroot, bilberries, and other fruits and vegetables may lead to a distinctly dark coloration, whilst the administration of rhubarb, senna and santonin is usually followed by the passage of urine of a deep yellow colour from the excretion of certain colouring materials which these drugs contain. The salicylates and resorcin are two other examples of drugs which may colour the urine dark brown.

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The aniline dyes which are sometimes employed to colour cheap sweets and ices frequently give a distinctly greenish-fluorescent appearance to the urine. Methylene blue, whether ingested in the same manner or directly as a drug, gives a colour to the urine varying from a deep green-blue to a light green according to the quantity of the drug taken.

None of the above-mentioned colorations have any pathological significance, but they cannot in all cases be distinguished by inspection alone from somewhat similar colours which are the result of pathological conditions. Thus a pink colour may denote the presence of a small quantity of blood pigment and a state of hæmaturia, of hæmoglobinuria, or of hæmatoporphyrinuria. By appropriate means the presence of blood pigment can of course be rapidly detected (see page 15). Should the blood pigment be present in larger quantity the urine will be coloured brown of greater or less intensity even to the degree of blackness. Black urine may also be encountered in those rare metabolic disturbances, melanuria and alkaptonuria, as well as in the condition of indicanuria, when a profound degree of intestinal putrefaction is responsible. But the two former are distinguished by the circumstance that the urine when voided is clear, and becomes black only on exposure to air.

Bile in the urine leads to an appearance which, although not easy to describe, is very characteristic. It is of a rich orange yellow, possessing a greenish tint, and the composite colour is particularly evident in the foam on the surface which is readily produced on shaking.

To sum up, then, an abnormal coloration of the urine may be due to the presence of an exceptionally large quantity of certain pigments which are normally present in urine, or to pigments present in certain drugs and foodstuffs, or to pigments derived from the

blood (and bile). Since it is the last named which constitute the only pathological constituents, it is for these alone that special tests must be performed, and these will be found under the corresponding headings.

The *odour* of normal freshly voided urine is peculiar and unmistakable. It is described as aromatic, but it is too familiar to demand description. It is more marked when the urine is concentrated. The characteristic odour may be altered in pathological conditions when decomposition, either intra- or extra-corporeal, has occurred and the urine has become ammoniacal or putrid, according to the degree and nature of the decomposition. In lesser degree even perfectly healthy urine becomes ammoniacal if left exposed for any considerable length of time.

In diabetes mellitus the urine may possess a distinctly sweet or acetone (ripe-apple) smell. Other odours are imparted by the presence of aromatic substances present in certain drugs or foods. Thus turpentine gives the odour of violets; copaiba and peppermint may contribute their characteristic smell; and asparagus and garlic are other familiar odours which can usually be identified.

The *reaction* of normal urine is acid to litmus. The acidity is due not to free acid, but to the acid salt, dihydric sodium phosphate (NaH_2PO_4), which is normally present with the monohydric salt (Na_2HPO_4) in the proportion of 3 : 2. The monohydric salt may, however, be present in increased amount; and as both phosphates are able to exert their own specific reaction, urine not infrequently exhibits the curious property of turning red litmus blue and blue litmus red—its amphoteric reaction.

The acidity of urine is increased if animal food in excess is taken. On the other hand, vegetable foods, being rich in bases, reduce the acidity. A tendency also exists for the acidity to diminish after any meal,

as the secretion of hydrochloric acid in the stomach sets free bases and leads to an increase of monohydric sodium phosphate. An alkaline urine may thus be secreted as such if hydrochloric acid is being rapidly satisfied or is not being normally produced, as for example in carcinoma of the stomach or in achylia gastrica. But more commonly when the urine is alkaline it has actually been secreted as a normal acid fluid and become decomposed in the bladder by the *Micrococcus ureæ*, alkalinity thus taking the place of acidity. Such a condition of alkalinity occurs in vesical stagnation from any cause, whether from stricture of the urethra, enlarged prostate, or spinal disease.

Finally, the urine can be rendered alkaline by the oral administration of the carbonates, citrates, or acetates of potassium, although the reverse process, the conversion of an alkaline into an acid urine, is not so easily performed.

The *specific gravity* of urine is on the average between 1012 and 1022. Variations depend so much upon many quite natural conditions that marked divergences from these figures are possible in the absence of any disease. Thus, if a large quantity of fluid has been ingested the specific gravity may fall to as low as 1005; whilst, on the other hand, during very hot weather, concentration may easily occur to raise the specific gravity to 1030. In diabetes mellitus, the normal expectation is a urine of high specific gravity, and in general one may say that light-coloured urine is associated with low specific gravity but that this is not always the case in diabetes mellitus, in which a very light-coloured urine of high specific gravity is frequently present.

Urine of low specific gravity is generally found in the condition of granular kidney and in diabetes insipidus. In the last named a urine with a specific gravity no higher than 1001 may be encountered.

The *quantity* of urine passed in twenty-four hours is on the average from 40 to 50 ounces, but may be subject to wide variations in perfect health. The quantity depends partly upon the amount of fluid taken and partly upon the relative activity of the sweat glands and the bowels, with consequent loss through these channels. Excretion through the lungs may also be an important factor if violent exercise is indulged in. Normally, the secretion of urine is reduced during the night: it is increased in arteriosclerosis, diabetes insipidus and mellitus, and in certain cardio-renal diseases when the diurnal secretion is reduced owing to circulatory demands but the tone of the vascular system under the recuperating influence of sleep improves so that secretion and excretion occurs at night of the fluid retained during the day. The whole subject of polyuria is considered in detail later (see page 46). For the present it suffices to mention that the total quantity of urine passed is pathologically increased in diabetes, granular kidney, and cerebral injuries. It is frequently much increased after an epileptic attack and in some hysterical conditions. It may also be noted that the quantity of urine may substantially exceed the total quantity of fluid ingested, desiccation of the tissues occurring to supply the excess, although, in normal circumstances, the 40 or 50 ounces passed in twenty-four hours represent two-thirds of the fluid taken. Diminution of urine is seen in acute Bright's disease, in cardiac failure, in fevers and conditions accompanied by low blood-pressure. It is diminished after any considerable loss of fluid from the body, particularly hæmorrhage, protracted vomiting and diarrhœa. And it is naturally diminished in conditions of suppression and obstruction to its passage.

CHAPTER II

ALBUMINURIA

THE presence of albumin in the urine is frequently regarded as evidence of disease of the urinary tract and especially of the kidneys. This, however, is far from being the case: albuminuria may be present to a comparatively large extent as a transient phenomenon of negligible character, and it may even occur as a persistent condition in the absence of any disease of the urinary tract. Its presence, then, does not indicate that some pathological condition is present; still less does it prove that the kidneys are diseased. Albuminuria must always be considered as a symptom to be correlated with all associated circumstances.

In any case in which albumin has been detected it is desirable to examine a centrifugalised specimen of the urine for cells or casts, which must in themselves constitute at least a part of the protein substance responsible for the positive test. One's view of a case completely alters with the discovery that such constituents are present.

It will be convenient first to consider those cases in which no deposit is discovered on microscopic examination, i.e. conditions of simple albuminuria. At this stage a few words may not be out of place respecting the usual tests for albumin which for ordinary clinical purposes are the following:

(1) *Nitric Acid Test (Heller's)*.—Pure concentrated (not fuming) nitric acid is poured into a test-tube to the height of 1 inch. The tube is then slanted and urine is gently poured (preferably through a pipette)

down the side of the tube so that it floats on the acid. The tube is then restored to the vertical position. A white cloud at the junction of the two fluids is a positive test for albumin: a dense coagulum forms if the percentage is large, a faint opalescence only if in lower concentration. In the latter event several minutes may elapse before the cloud is clearly visible.

Certain precautions are necessary in connection with this test. Mucin occasionally precipitates out, but higher up in the urine than at the junction level. Concentrated urine containing a large amount of urates often yields a precipitate of urea nitrate, but the colour is yellow rather than white. If any doubt exists as to the nature of the precipitate, the urine should be diluted and warmed before being added to the nitric acid. Sometimes the urine of patients who are taking copaiba may become turbid on the addition of nitric acid.

(2) *The Boiling Test.*—The reaction of the urine is first taken. If alkaline or not distinctly acid, a few drops of dilute acetic acid are added. A test-tube is then filled to three-fourths its capacity and the upper part of the column is boiled, the tube being held obliquely in the flame for this purpose. The presence of albumin is indicated by turbidity of the portion boiled, such turbidity varying from a faint haze to a dense coagulum which may be practically solid. Acetic acid is then added to the urine; persistence or even increase of the turbidity occurs if albumin is present; should the cloud disappear, its presence was due to phosphates or carbonates only. In any case, even if the urine is definitely acid, a few drops of dilute acetic acid should be added after boiling, whether turbidity is present or no.

Many other more delicate tests for albumin have been elaborated, but for clinical purposes the above-

mentioned are not only sufficiently reliable but sufficiently delicate. Before leaving the subject, however, a point of special consideration relating to the boiling test must be mentioned.

Should a precipitate appear when the urine is heated *and gradually dissolve as the heating is continued* until it has completely disappeared when the urine boils, the rare condition of *Bence Jones albumosuria* is present. This protein body is specifically associated with multiple myelomata, and it is conceivable that the urinary phenomenon to which it gives rise might be overlooked if the boiling test were not carefully conducted.

Albuminuria without Evidence of Disease.

Many terms are in current use to express this condition, such as "physiological," "postural," "intermittent," "functional," "transient," "adolescent," "cyclical," "orthostatic," "familial" albuminuria and "leaky kidneys." Whilst these various terms have certain special features, they have in common the circumstance that the individual in question displays the peculiarities familiar in vasomotor asthenia and most frequently exhibited at the period of adolescence, when neuro-circulatory disturbances are likely to be produced owing to instability of the vaso-motor system at this time of metabolic stress. An important investigation in all cases of albuminuria is the estimation of the blood-pressure which, in subjects under present consideration, is invariably low. It has been observed that the type of young adult who is prone to such attacks of albuminuria is also liable to attacks of fainting upon exposure to cold and deprivation of food. The postural element is indicated by the circumstance that whilst the early morning urine is free from albumin, that passed about 10 or 11 a.m., after the subject has been up and about, exhibits the

phenomenon which again disappears by evening. If he remains in bed, or at least in the horizontal position, all day, the urine will be free from albumin. In the majority of such subjects the lumbar spine is markedly lordotic, and in certain cases it is possible to induce a temporary albuminuria by placing the subject in an appropriate posture for a quarter of an hour. It is suggested that distension of the renal veins with congestion of the kidneys may be the determining factor, and it has been claimed by some Continental workers that in this type of albuminuria the urine from the left kidney (as shown by catheterisation of the ureters) alone exhibits the peculiarity, due, it is suggested, to pressure of the ureter on the left renal vein. But in any case the mechanical element does not appear to be the only one; there must be some physiological peculiarity, such as decreased coagulability of the blood, since the administration of calcium chloride or lactate will often prevent the albuminuria. It may be noted that part of the protein in these cases is frequently a mucin or nuclein compound, and not all serum albumin or globulin.

The albuminuria which occasionally follows very strenuous exercise is again hardly to be considered a pathological condition. It has been observed on several occasions after a very hard boat race. One of the present authors has had considerable experience of the physiological effects of track athletics, and he has failed to detect albumin in the urine of both short and long distance runners even after very severe exertion, for which reason it may be assumed that the exertion alone is not responsible, but that the posture of the oarsman during his exercise may also be a factor.

In some susceptible persons albuminuria follows a cold bath, again in all probability as a vaso-motor phenomenon.

A condition which has been described as "alimentary albuminuria" may occur analogous to alimentary glycosuria, when the ingestion of an excessive amount of protein food may be responsible for its appearance in the urine. This condition is not so common as one in which, owing to an idiosyncrasy, white of egg reaches the blood unchanged, to be excreted from the body through the kidneys.

It is perhaps necessary to interpose as a warning that the passage of urine shortly after a seminal emission may lead to the identification of albumin, owing to the presence of spermatozoa and prostatic secretion, and that the same condition is almost invariable in women from admixture with vaginal and vulval secretions, unless a catheter specimen has been taken.

Albuminuria is not uncommon during pregnancy, as a physiological sequel of the extra work thrown upon the kidneys by the placental circulation, but such a condition cannot in itself be distinguished from a more serious pathological albuminuria due to irritation of the renal epithelium by foetal products, and constituting one of the toxæmias of pregnancy. In such an event associated symptoms must be taken into consideration.

When considering albuminuria in pathological circumstances, it is found that variable degrees of albuminuria are not uncommon in many febrile conditions, particularly in scarlet fever, diphtheria, follicular tonsillitis and pneumonia; and although such a condition is often transient only, it is hardly possible to deny that the toxin in question may have induced an actual nephritis, more especially as the quantity of albumin is larger than one is accustomed to see as an accompaniment of a purely febrile condition, and is more persistent, although subsidence during convalescence is the rule.

Albuminuria of slight or moderate degree occurs in cardiac failure, in cirrhosis of the liver, in obstruction of the inferior vena cava from thrombosis or external pressure, and in primary anæmias and severe secondary anæmia, again from the circulatory disturbances or changes in the blood which occur in these conditions.

A small amount of albumin is also frequently present in chronic alcoholism, in gouty subjects, in sufferers from Graves's disease and myxœdema, and not uncommonly after apoplectic and epileptic attacks, when traces of sugar may also be present.

Albuminuria and Renal Disease.

Up to this point albuminuria has been regarded as due to a variety of conditions among which disease of the urinary tract is not included. It is now necessary to distinguish those cases in which albuminuria is an index of a renal disease and in which, as has already been said, the identification of certain cellular elements in the deposit microscopically examined is of importance.

The deposit may consist of pus cells, blood cells, or urinary casts. These may or may not be responsible for the whole of the albumin present, but until their origin and significance has been established the circumstance that albuminuria in greater or less amount is present recedes into the background.

The presence of blood constitutes the condition hæmaturia (or hæmoglobinuria), to which the reader is referred as a separate consideration in Chapter III.

Similarly as regards pus: the subject of pyuria is considered in Chapter IV.

The remainder of this chapter will be devoted to the subject of casts, i.e. nephritis, acute and chronic.

Casts.

Whilst the occasional presence of isolated casts cannot be considered as pathological, speaking generally they denote nephritis. The nature of the cast is of considerable importance in order to assess the character and severity of the renal lesion which is responsible for their production.

The simplest form of cast is one which is composed of a structureless, almost transparent matrix, this type is called *hyaline*, and its exact formation (and relative significance) is still a matter of dispute among pathologists, some of whom regard it as a result of coagulation of mucus, and therefore unimportant. (The term *cylindroid* is sometimes employed for an aggregation of salts, e.g. phosphates or urates held together by mucus and drawn out so as to resemble a renal cast.) Embedded in such a matrix may be recognised epithelial cells, red blood corpuscles, white blood corpuscles, granular debris or fat globules, according to which the casts are designated epithelial, blood, leucocytic, granular, and fatty casts respectively. Blood casts alone may be present in any condition of hæmaturia, whether nephritis is present or not, and their existence is no evidence of nephritis unless other casts are also present.

Casts may occur in the following conditions :

(1) Malignant disease of the kidney. A microscopical examination of the urine will almost certainly show the presence of fragments of new growth.

(2) Infarction of the kidney. In the great majority of cases, malignant (infective) endocarditis is present and definable by other clinical evidence, notably cardiac murmurs, intermittent pyrexia, the presence of hæmorrhages, e.g. in the form of petechiæ, or in the retina or of other infarcts, e.g. the spleen or lung. Increasing anæmia will also occur.

(3) Lardaceous disease of the kidney, nowadays a rare condition, which (together with lardaceous disease of other viscera) accompanies long-standing suppuration and chronic wasting diseases, e.g. bronchiectasis, tuberculosis, tertiary syphilis. No special urinary features characterise this disease, although lardaceous casts which give the typical reaction with iodine may occur. The diagnosis is inferred from the evidence of renal disturbance in the presence of one of the diseases referred to.

(4) Acute nephritis. In most cases, but not invariably, the condition is characteristic, pyrexia, anasarca, especially œdema of the face, ankles and genital organs, with scanty concentrated urine containing blood cells and casts of any or all descriptions. Such a disease may be primary and occur in the course of an acute illness, e.g. scarlet fever, diphtheria, influenza, pneumonia, or as an acute exacerbation of a previously existing (chronic) nephritis. (See page 70.)

(5) Nephritis in pregnancy. This would appear to be a special form of acute nephritis due to some toxin elaborated by the foetus or by the mother.

(6) Chronic nephritis. The quantity and nature of casts varies considerably. Blood casts which denote an acute inflammatory condition are absent, and epithelial casts are comparatively scanty. In many cases of chronic nephritis casts are to be found only in the smallest numbers. (See page 74.)

CHAPTER III

HÆMATURIA

IN the consideration of blood in the urine there must first be distinguished admixture with the colouring matter (hæmoglobin) only: hæmaturia proper means admixture with all the constituents of blood. Whilst all the various chemical tests for blood are given by both conditions—since they depend on the presence of hæmoglobin—the essential feature, the identification by the microscope of red blood corpuscles, alone enables one to decide that true hæmaturia is present.

The advantage of microscopical examination is not only to obtain unequivocal evidence that blood and not hæmoglobin alone is present, but it ensures the identification of minute quantities which would not be detected by other means, however delicate.

The chemical tests most frequently employed are the following:

(1) *The Preparation of Hæmin Crystals.*—The urine is centrifugalised, and the deposit obtained is placed on a microscopic slide. To it are added a grain of sodium chloride and two drops of glacial acetic acid. A cover-glass is then placed over the whole and the mixture heated to boiling. On cooling, small brown crystals of hæmin, which are rhombic plates with bevelled edges, will be visible microscopically. Although in certain circumstances this test may have special advantages, it is superseded in ordinary clinical practice by one of the following.

(2) *The Guaiacum Test.*—A few drops of freshly

prepared tincture of *guaiacum* are added to 10 c.c. of urine in a test-tube. Ozonic ether is then poured slowly down the side of the tube. The test may alternatively be performed by making a dilute solution of the tincture in ozonic ether and adding that to the urine. A blue coloration indicates the presence of blood, but if the latter is in small quantity only, the reaction may not appear until the test-tube has been slightly warmed. The guaiacum reaction is not specific for blood but is on the whole satisfactory for ordinary clinical practice. Whenever possible, the benzidin test should be performed.

(3). *The Benzidin Test*.—A supersaturated solution of pure benzidin in glacial acetic acid is first prepared. The urine to be tested is thoroughly boiled and then allowed to cool. To ten drops of the benzidin solution the same quantity of urine is added, followed by twenty drops of hydrogen peroxide (20 vols.). A positive reaction is a blue or bluish-green coloration within half a minute. The test is very delicate, and its delicacy is sometimes advanced as an objection to its clinical employment; but if care and cleanliness are observed, there can be no real disadvantage in its use in ordinary practice.

Spectroscopy.—If the urine is very dark, it should be diluted before examination. The presence of oxy-hæmoglobin will be evident by the two characteristic bands in the spectrum or by the additional band if methæmoglobin is present. The addition of ammonium sulphide solution reduces hæmoglobin to the state of "reduced hæmoglobin" characterised by a single broad band.

In rare cases the special absorption spectrum of hæmatoporphyrinuria may be detected.

Before dealing with the differential diagnosis of the site in the urinary tract from which the blood may

be derived it will be convenient to systematise the possible causes of hæmaturia as follows :

A. Diseases of the Urinary Tract.

(1) *Renal.*

Trauma, Neoplasm, Calculus, Tuberculosis, Acute Nephritis, Granular Kidney, Coli Bacilluria, "Idiopathic or Essential Hæmaturia." (Under trauma may be included such causes as irritation of the kidney by turpentine or cantharides.)

(2) *Ureteric.*

Impacted Calculus, Neoplasus.

(3) *Vesical.*

Trauma, Neoplasm, Papilloma, Calculus, Tuberculosis, Acute Cystitis, Deposition of Bilharzia Hæmatobia.

An enlarged (vascular) prostate may be included in this category.

(4) *Urethral.*

Trauma, Calculus, Caruncle, Nævus, Acute Urethritis, Malignant Disease.

B. Extra-Urinary Causes.

(1) *Hæmorrhagic Fevers.*—The hæmaturia may, however, be due to an actual acute nephritis. This was certainly the case in the last influenzal pandemic, when hæmaturia, apart from acute nephritis, was not seen in cases investigated *ad hoc*.

(2) *Infarction of the Kidney.*—In this condition infective endocarditis is invariably present.

(3) *Arterio-sclerosis.*—Hæmorrhages from any mucous surface are not uncommon in conditions of high blood-pressure, and hæmaturia may occur from this cause alone.

- (4) *Primary Blood Diseases*: the leukæmias, pernicious anæmia, splenic anæmia, purpura hæmorrhagica, hæmophilia.

Notwithstanding this formidable list of causes, it is almost always possible fairly rapidly to narrow down the most likely situation of the lesion from the history of the onset or from associated circumstances. It will be best, perhaps, to eliminate the commonest conditions first and to assume that the patient is not obviously acutely ill, as would naturally be the case in acute nephritis and in any of the hæmorrhagic fevers. Further, any injury capable of producing hæmaturia would certainly be of a sufficiently severe character to call attention to the viscus affected. It is possible, though hardly probable, that poisoning by cantharides or turpentine could be overlooked.

A distinction of great importance is to ascertain whether or not the onset of the hæmorrhage was sudden and accompanied by pain. In this connection it is manifest that we are dealing with a condition of frank hæmaturia so conspicuous that the patient's attention is drawn to the abnormality, and not to the presence of small quantities of blood which are not macroscopically conspicuous, but which are discovered during microscopical investigation.

Sudden onset with unilateral lumbar pain suggests a renal origin. The kidney may be unduly tender on palpation. These features do not always enable one to define the nature of the renal lesion, but an examination of the heart would confirm any suspicion that renal infarction had occurred. It must be mentioned, however, that slight degrees of hæmaturia may occur in infective endocarditis without the symptoms of infarction, and in fact the identification of blood in the urine by the microscope has pointed

the way on many occasions to a diagnosis of infective endocarditis with obscure symptomatology.

Malignant tumours are always the cause of *profuse* hæmaturia, a symptom always very suspicious if a tumour in the loin is palpable. Renal tuberculosis or calculus is rarely accompanied by very profuse hæmorrhage. The rapid development of a varicocele is a significant point if a renal growth is suspected.

Sudden onset without pain suggests a vesical origin, e.g. papilloma, or an early case of prostatic enlargement with vascular engorgement. In either of these conditions blood may be passed in considerable quantity independently of micturition, as would also occur in that rare condition urethral nævus, as well as in commoner pathological conditions of the urethra (*q.v.*).

As a simple and convenient distinguishing investigation may be mentioned the three-glass test, in which the patient is requested to micturate in three portions. Should most blood appear in the first urine passed or blood be passed, at once independently of urine, a urethral cause for the hæmorrhage is suspected; should the urine be equally coloured in all three cases, a renal origin is probable; whilst if the last urine passed is more bloody than the others, the source is most likely vesical. But such a means of differentiation is crude, and, whenever possible, urethroscopy or cystoscopy should be employed.

Blood arising from the urethral mucous membrane independently of micturition may be due to (1) trauma, (2) urethral calculus, (3) malignant growth.

The antecedent history of trauma is always sufficient to enable a diagnosis to be established without the aid of special investigation. In connection with trauma one must not forget the passage of an instrument which may have resulted in injury. Instances,

too, occasionally occur when a pin or other foreign body has been pushed into the urethra. Should rupture of the urethra be complete, surgical treatment is urgently necessary. Should the rupture be incomplete, in which case there will be neither extravasation of urine nor a swelling in the perineum, the patient is at once confined to bed, an injection of morphia, $\frac{1}{4}$ grain, is administered, and a catheter (No. 22 French size) is passed and tied in position. The latter should not be retained longer than seven days. Eventually stricture develops, for the treatment of which the reader is referred to page 109.

When hæmorrhage follows instrumentation, it will almost invariably cease if the patient is put to bed and given morphia. But should bleeding persist, a large catheter (No. 22 or 24 French size) should be inserted into the urethra and retained, as in the case of incomplete rupture just mentioned. In such cases it is well to irrigate the bladder with warm nitrate of silver solution, 1 in 8,000, to wash out any clots which collect in the urethra or bladder.

A urethral calculus is best diagnosed by the urethroscope, but should the practitioner not find its passage convenient, the use of a sound will suffice; a click is heard when the instrument touches the stone. Sometimes the stone becomes impacted in the urethra, causing urgent distress in addition to hæmorrhage. For its removal a general anæsthetic is preferable, but the operation may be performed under local anæsthesia, two drachms of 2 % novocaine solution being injected into the urethra with a suitable syringe and held there for five minutes by digital compression of the penis. If the stone is situated in the anterior urethra, it may then be extracted with crocodile forceps. If in the posterior urethra, it should be forced back into the bladder by Bigelow's evacuator and cannula (an

operation demanding a certain amount of special experience) and subsequently crushed with a lithotrite. Finally, should the stone lie behind a stricture, external urethrotomy must be performed.

A malignant growth of the urethra does not cause spontaneous hæmorrhage until ulceration occurs. At this stage of the disease the urethroscope must be employed as an aid to diagnosis. (See also page 108.)

If the site of the hæmorrhage is vesical, this will be evident on cystoscopic examination. Furthermore, such an investigation will, even in those cases when the bladder can be exonerated, enable the observer to see the condition of the ureteric orifices, to collect urine separately from the two kidneys, and so obtain evidence to show which side is at fault and material whereby supplementary evidence of the nature of the renal lesion may be secured. For example, if the urine from both ureters contains blood, the surgeon can exclude a renal growth.

Microscopical Examination.—In addition to blood cells, the urine may contain pus cells, fragments of new growth, ova of *Bilharzia hæmatobia*, renal casts, crystals of oxalates. Naturally, should any of these constituents be identified in the urine obtained from one ureter by separation whilst the urine from the other kidney is normal, unequivocal evidence as to which side is affected is obtained. But if separation has not been practicable, one may be compelled to correlate the pathological condition of the urine with the symptoms referred to one or other side with in some cases misleading results.

Unilateral pain in the lumbar region radiating to the groin or testicle of that side, produced or aggravated by exertion or jolting, as in riding or driving over rough surfaces, is the typical history of renal calculus. Such attacks of pain are intermittent, colicky in

nature, and accompanied by a fair degree of hæmaturia. In the urine, pus cells and crystals, particularly of calcium oxalate, are often to be found. The diagnosis would be strongly supported by radiographic examination in which a shadow, the outline of a calculus in appearance, was visible.

Such a stereotyped description is not generally ratified. A large calculus of pure uric acid may throw no shadow for example, and the surgeon must then rely upon such evidence as is available—the condition of the urine and the history of the attacks, with the absence of any other disease capable of producing such symptoms. The treatment of renal calculus is considered in detail in the chapter on stone in the urinary tract. (See page 115.)

Oxaluria, in which crystals and blood are passed with the urine, occurs in some persons particularly predisposed, and especially after the ingestion of rhubarb and tomatoes. In these no X-ray shadow will be found. (See Oxaluria, Chapter VI.)

In acute nephritis no localising symptoms occur. The urine is scanty, and contains casts as well as blood cells. The associated features—a severe illness with pyrexia of sudden onset or following a recent attack of scarlet fever—point to the diagnosis. (See page 70.)

In chronic nephritis, hæmorrhage from the kidneys may be the only sign. (See page 74.)

Tuberculous disease of the kidney may not be suspected from the general condition of the patient, but investigation may be suggested from the circumstance of persistent slight hæmaturia with pyrexia and urinary frequency being discovered in a young adult. Specific examination for the tubercle bacillus is essential, and this may involve injection of urine into a guinea pig. The routine palpation of the epididymes and, by rectal examination, the vesiculæ seminales and prostate

must of course not be omitted. (See the special consideration of tuberculous disease of the urinary tract, page 87.)

In vesical disease, other than tumours or early prostatic enlargement, there will be a history of tenesmus, of suprapubic pain and of frequency of micturition both by day and night. Such a history denotes cystitis, either of acute onset or accompanying some other vesical condition such as calculus. In vesical calculus which has not yet caused cystitis, diurnal but not nocturnal frequency is to be expected.

In the vesical causes now to be considered bleeding is most usual at the end of micturition. The same symptom is commonly encountered in the acute urethritis of gonorrhœa, with which confusion is not likely.

If acute cystitis is present, it will be suggested by the history of sudden urgent micturition followed immediately by the passage of a few drops of blood. In such a case the temperature soon rises and blood is passed mixed with urine in small quantities at frequent intervals. There is a good deal of pain both on the passage of urine and independently of micturition. Cystoscopy in such a case shows an acute inflammatory condition of the whole mucous membrane of the bladder. (Cystoscopy at the same time eliminates other causes of vesical hæmorrhage, such as papilloma, stone, or bilharziasis.)

The patient should remain in bed so long as fever and painful micturition persist. Morphia will generally be needed for the pain, and if, as is frequently the case, the *Bacillus coli* is the organism responsible, large doses of sodium bicarbonate are administered to render and maintain the urine alkaline. If the organism isolated is of the cocci group, the urine should be rendered acid (by acid sodium phosphate), and

urotropin is given. In either case alcohol is contra-indicated, and the diet should be bland, consisting chiefly of milk and barley water.

Lavage should never be employed in the case of acute cystitis, the mucous membrane is too irritable to tolerate such treatment.

Stone in the bladder is most easily identified by cystoscopy, but skiagraphy may sometimes be of assistance, or the diagnosis may be made by the passage of a bladder sound. Unless the stone is very large and associated with an enlarged prostate or lying in a diverticulum, litholapaxy will suffice for its removal. Suprapubic cystotomy is an alternative treatment. (See further, Chapter XVII.)

Whilst adenomatous enlargement of the prostate may cause hæmaturia, carcinomatous disease of the prostate is not usually accompanied by hæmorrhage. Cystoscopy will reveal the presence of a tumour which may be entirely intravesical, and therefore not palpable by rectal examination.

For treatment, see Chapter XV.

Bilharziasis.—This condition should be suspected as a possibility when hæmaturia is under consideration in patients who have lived in South Africa and Egypt. The authors saw many cases during the War in soldiers who had returned from the East, and frequently the disease in question had been overlooked as unfamiliar in this country.

The characteristic ova will be evident in the urine microscopically, and a deposit upon the bladder wall may be seen cystoscopically. In some cases a curious and very characteristic symptom is present, viz. a drop or two of blood appearing at the urethral orifice absolutely at the end of micturition.

Until comparatively recently no treatment appeared to benefit this condition. Many observers have now

reported excellent results by the use of tartar emetic given intravenously. For detailed description of this form of treatment the reader is referred to Dr. Christopherson's articles in the *Lancet* of September 7, 1918, and June 14, 1919. The drug is injected in a dosage at first of $\frac{1}{2}$ grain three times a week. The dose is then increased at each subsequent injection up to a maximum of $2\frac{1}{2}$ grains. In all, 25 grains are given.

The occurrence of hæmaturia in blood diseases may occasionally present itself as an isolated feature for explanation. More usually the diagnosis has been made, and a particularly close watch is then kept upon the urine for evidence of hæmorrhage. We have already mentioned that in infective endocarditis microscopical examination of centrifugalised urine may reveal the presence of blood corpuscles, often in itself a link in the chain of evidence of a doubtful case of this disease.

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As will be seen in the list of possible causes of hæmaturia at the head of this section, a small residue of question-begging causes must always remain, and occasionally a case presents itself for which the most elaborate investigation fails to supply a reason. If a sufficiently high blood-pressure is present to justify a diagnosis of arterio-sclerosis, especially if the urinary symptoms familiar in granular kidney are present, a fairly satisfactory explanation is at hand. Otherwise one is compelled to assume the possibility of a renostaxis, analogous to "epistaxis of idiopathic origin" and gastrostaxis. Most of such cases do not call for treatment, although the symptom is naturally alarming to the subject. One such case came under the authors' care and was submitted to prolonged observation, during which the amount of blood thus lost at each period of hæmorrhage was estimated.

It was found to be really trivial in extent, although imparting a very decided colour to the urine. Exploratory nephrotomy in such cases leads to the discovery of no lesion, but after incision of the kidney cure has sometimes followed.

Hæmoglobinuria.

This condition will hardly be suspected until, on making a systematic examination of a urine obviously containing much blood, few or no corpuscles are found. The condition is due to the destruction of red corpuscles within the bloodvessels, resulting in hæmoglobinæmia, the free hæmoglobin being removed from the blood plasma by the kidneys. Such destruction may be caused by certain poisons, e.g. potassium chlorate, or occur in certain pathological states, e.g. blackwater fever, but the most important clinical condition with which it is associated is *paroxysmal hæmoglobinuria*, the pathology of which is obscure. It is induced in susceptible subjects through exposure to cold. In certain cases Raynaud's disease also occurs at the same time of exposure, for which reason a vasomotor influence is supposed. But it has been noted that in most subjects of paroxysmal hæmoglobinuria the Wassermann reaction of the blood is positive, so that syphilis plays a part in its causation.

In a typical case of hæmoglobinuria the urine does not look like blood mixed with water, but resembles rather a black liquid, e.g. porter, the hæmorrhagic character of which becomes more evident on dilution. Filtration perceptibly diminishes the colour in the case of hæmaturia, but not of a urine in which hæmoglobin alone is present. As we have already mentioned, the microscope is the distinguishing test, the chemical reactions and the spectroscopic peculiarities being due to the blood pigment,

CHAPTER IV

PYURIA

WHEN investigating a case of suspected pus in the urine it is well to remember that the specimen to be examined should be taken from the total urine passed in twenty-four hours.

The familiar method of testing for pus in the urine is to add an equal quantity of caustic potash solution and to mix the two liquids by rapidly passing them backwards and forwards between two test-tubes. A positive result is the production of a gelatinous ropy mass. The best and most accurate test is identification of the typical pus cells under the microscope. Pus cells are leucocytes undergoing degeneration; they are well stained by a solution of iodine in potassium iodide.

If the presence of pus is detected, the practitioner may then proceed to further tests to enable him to locate the seat of the disease. Thus the two-glass test will assist in excluding the urethra and prostate as the organs involved. If the urine passed into the first glass contains pus and into the second is clear, the pus can only come from the prostate or urethra. On the other hand, when there is pus in both specimens, these regions cannot be definitely excluded, for such a condition exists in prostatic abscess but it demonstrates that the seat of inflammation may be in the upper urinary tract.

In every case of pyuria the urine must be submitted to bacteriological examination. As an example of the necessity of such a routine examination one of

us recalls a case of pyuria with slight muco-purulent discharge from the urethra. There was a history of an attack of gonorrhœa twelve months previously, and a diagnosis of chronic prostatitis of venereal origin had been made. However, bacteriological examination demonstrated the presence of the tubercle bacillus, and further investigation revealed extensive tuberculosis of the prostate and base of bladder.

If a urethral origin for pyuria has been established urethroscopy should be performed. Thus may be diagnosed a commencing stricture, early malignant disease of the urethra, stone, and chronic inflammatory affections of the prostate. Should the two-glass test favour the view that the origin of the pus is in the bladder or kidneys, the cystoscope must be requisitioned to assist in the diagnosis. If cystitis is discovered, then it will be necessary to determine whether this condition is primarily vesical or secondary to a lesion in another part of the urinary tract. By the aid of the cystoscope it is possible to note whether a purulent urine is escaping from one ureter or both. Having excluded the genitalia as the source of infection of the bladder, and if there is no evidence of spread of infection from the urethra, it is a wise procedure to catheterise both ureters and make a bacteriological examination of the urine excreted from each kidney.

The diagnosis of medical diseases of the kidneys is greatly aided by an examination of the urine from each side. In this way the physician may obtain valuable data with regard to the involvement of one or both organs. Finally, much information may be gained by radiography of the whole urinary tract. By its means we are able to judge the size of the kidney, and the presence or absence of shadows in any of the urinary organs. The more common causes of pyuria are set

out in the following table, and their diagnosis and treatment discussed in the chapters that deal specifically with affections of the different urinary organs.

I. Diseases of the Urethra.

(a) Urethritis.

(1) Gonococcal.

(2) Traumatic, from catheter or presence of stone.

(3) Tuberculous.

(b) Malignant disease of urethra.

(c) Stricture of urethra.

II. Diseases of Prostate.

(a) Prostatitis.

(1) Gonococcal.

(2) Non-gonococcal

(b) Stone: in the prostate gland.

III. Diseases of Bladder.

(a) Cystitis.

(1) Primary.

(2) Secondary—tuberculous and non-tuberculous.

(b) Malignant disease.

(c) Bursting of abscess into bladder from without.

IV. Diseases of the Kidney.

(a) Pyelonephritis.

(1) Tuberculous.

(2) Non-tuberculous.

(b) Pyonephrosis.

(1) Primary.

(2) Secondary to calculus or growth.

CHAPTER V

GLYCOSURIA

THE capacity of metabolising sugar is a variable one. Thus the ingestion of so large a quantity as 6 ounces of glucose will, save in rare exceptions—sufferers from pituitary insufficiency with an abnormal sugar tolerance—result in the excretion of sugar by the kidneys within the following hour (“alimentary glycosuria”). In the average healthy person glycosuria will not result from the administration of 4 ounces of glucose, although every individual has a natural limit beyond which his capacity to metabolise sugar does not extend, so that in some alimentary glycosuria is much more readily produced than in the majority; and although this may be only after the ingestion of a comparatively liberal sugar allowance, such persons are regarded as possessing an inferior carbohydrate metabolism and to be likely candidates for diabetes. In another class are placed individuals who excrete sugar after taking carbohydrate food in ordinary quantities, whilst the most severe sufferers from diabetes exhibit glycosuria even when all carbohydrate food is withheld, and metabolise it from protein.

Quite apart from the question of alimentary glycosuria, many other conditions which are not diabetes are noted when sugar may appear in the urine. Thus a small degree of intermittent glycosuria is not infrequent in gouty subjects, and especially in those addicted to alcoholic excess. It is often present in Graves’s disease. In tumours of the brain and in certain chronic diseases of the nervous system, especially

when the meninges are the seat of long-standing syphilitic disease, sugar may appear in the urine, and the same phenomenon is to be expected in acromegaly—excess of the secretion of the posterior lobe of the pituitary gland.

Glycosuria as a transient phenomenon is not uncommon in children, particularly during and shortly after an attack of pertussis.

A condition sometimes occurs in which the kidneys possess a permeability for sugar analogous to the "leaky kidneys" which allow albumin to pass and so appear in the urine (see page 11). In this type of "renal glycosuria" carbohydrate metabolism itself is not at fault.

As a physiological phenomenon, sugar is frequently present in the urine of pregnant women and nursing mothers, but in this condition the sugar is not glucose, but lactose, absorbed from the mammary glands and passed through the liver unchanged: its presence ceases with the termination of lactation.

A rare condition of sugar in the urine is presented by pentosuria, the sugar in this instance being pentose, not glucose. It is the result of some metabolic disturbance, but is not diabetes, although frequently mistaken for this disease. It will be referred to later.

Glycosuria may exist for a comparatively long time without giving rise to any symptoms whatever, and it may be detected for the first time during a routine investigation of the urine. The diabetic subject may present himself with any of a large variety of symptoms other than those referable to the urinary tract. For example, the complaint may be of pains in the legs, and peripheral neuritis may be present. Or there may be general symptoms of lassitude, weakness and loss of weight; tuberculosis, Addison's disease, or malignant disease being simulated. Ocular symp-

toms may be the first subjective manifestations, and diabetic retinitis or cataract be identified. The patient may complain of persistent and repeated crops of boils or attacks of eczema, or suffer from perforating ulcer of the foot or of gangrene of some distal portion of the body. A common symptom is an abnormal hunger or thirst, the latter more commonly than the former. And, finally, the complaint may be of increased frequency of micturition, although polyuria and not pollakiuria is the real condition.

Whilst a routine test for sugar should never be neglected in the detailed examination of any patient, this precaution is particularly desirable should any of the above-mentioned signs and symptoms be presented.

It will be convenient at this stage to describe the tests for sugar, by which one means glucose. For clinical purposes either *Fehling's* or *Benedict's* test are the most convenient to employ.

Fehling's test will demonstrate 0.02 % glucose. The solution employed is an alkaline solution of potassium-tartrate of copper, and its composition is:

(A) 34.64 grams of pure copper sulphate dissolved in 500 c.c. of distilled water.

(B) 180 grams Rochelle salt and 70 grams of sodium hydrate dissolved in 250 c.c. of distilled water: when cold the solution is diluted by the addition of distilled water to 500 c.c.

These two solutions should be kept separately, as the combined reagent tends to become self-reducing. At the time of performing the test, equal parts are mixed and boiled. An equal quantity of urine is separately boiled and added. Should reduction not occur—a brick-red precipitate (cuprous oxide) or a yellow precipitate (cuprous hydroxide)—the absence of sugar may be assumed. In practice the boiling urine is added a few drops at a time, whereby some

impression of the quantity of sugar present may be obtained. An equivocal reaction—a greenish-yellow coloration, but not a precipitate, is sometimes seen; and since prolonged boiling tends to produce such a colour with a normal urine, it is advisable not to boil the mixture, but to mix the two separately boiled liquids, which procedure should be sufficient to detect or exclude the presence of sugar.

Precautions.—(1) If albumin is present, it should first be separated by boiling and filtering before the Fehling's test is performed.

(2) Avoid prolonged boiling, which may enable substances present in normal urine to reduce Fehling's solution. Such substances are uric acid, creatinin and glycuronic acid. The first named will rarely be present in sufficient quantity to give the reaction; creatinin will do so only on prolonged boiling. The interest and importance attaching to glycuronic acid is that it may appear in the urine of a patient taking chloral.

(3) Although the specific gravity of sugar-containing urine is usually high, this is not necessarily so. The mere circumstance that the specific gravity is comparatively low should never be a reason for neglecting to perform the test. Diabetes mellitus has been discovered with a urine of specific gravity 1008.

Benedict's test, although far less frequently employed, is really much simpler and its results are less equivocal. The composition of Benedict's solution is:

Copper sulphate, 17·3.

Sodium (or potassium) citrate, 173.

Crystallised sodium carbonate, 200.

Distilled water to 1,000.

The test is performed as follows: Eight to ten drops of urine are added to 5 c.c. of the solution;

excess of urine should be avoided. The mixture is boiled for two minutes and then cooled. If a small amount of sugar is present, a green, yellow, or red precipitate slowly forms; if a large quantity, the precipitate appears rapidly before cooling takes place. An important advantage is that the substances other than glucose above enumerated, which reduce Fehling's solution, do not reduce Benedict's solution. Perhaps a disadvantage which prejudices its more general use is its great delicacy; 0.01 % sugar can thus be detected.

Confirmatory Tests.—The decomposition by yeast of sugar into alcohol and CO_2 affords a method both of identifying the presence and estimating the quantity of sugar, which for several reasons will always make a strong appeal to the practitioner. In the first place, the procedure is exceedingly simple, and yet sufficiently accurate for clinical purposes—0.05 % sugar can be demonstrated. In the second place, the presence of uric acid, xanthin, creatinin and glycuronic acid become of no consequence, as they do not enter into the reaction. Thirdly, only fermentable sugars will be detected, hence pentose (which is a non-fermentable sugar) cannot be mistaken for glucose. Fourthly, as has already been stated, estimation of the quantity of glucose can be made by a simple calculation. The test is performed as follows: The urine should first be tested with Fehling's solution or Benedict's solution, and the presence of a reducing substance identified. The specific gravity is then noted. A piece of yeast the size of a filbert, or two or three pieces according to the amount of urine utilised, is then added, and the urine is left for twenty-four hours, preferably at a temperature of about 77° Fahr. At the end of this time the urine is again tested, and if reduction no longer occurs fermentation is complete, otherwise the urine is left for a longer period. When fermentation

has been completed, the specific gravity is again taken. The rationale of the experiment is that owing to the decomposition of the sugar the specific gravity falls, and it has been found that every degree of specific gravity lost represents (accurately enough for clinical purposes) 1 grain of sugar per ounce ; or, if 100 c.c. urine have been utilised, the difference in specific gravity $\times 0.23$ gives the percentage of sugar.

It is possible to calculate from the amount of alcohol formed or the volume of CO_2 evolved, but the reduction in specific gravity which is far simpler is sufficiently accurate.

The property possessed by sugars of rotating the plane of polarised light affords a method of differentiating sugars from one another according to the direction of rotation and also of calculating the percentage of sugar, but this is not a method which could be regarded as clinically convenient. Another method, however, may be mentioned which on special occasions may be of use in differentiation, the phenylhydrazine test. In a test-tube are mixed together 15 c.c. of urine and sufficient of phenylhydrazine hydrochloride and of sodium acetate to lie on a sixpence. The mixture is boiled for ten minutes, employing a water-bath rather than the naked flame. After allowing to stand for half an hour, the deposit is pipetted off and examined microscopically with the $\frac{1}{8}$ inch objective for "osazone crystals," which are not merely characteristic of sugar, but specifically characteristic for each particular sugar, both as regards appearance and as regards their melting-point. Any elaborate differentiation is hardly likely to be useful to the practitioner, but on occasion he may desire to know if a certain reducing substance found in the urine forms an osazone.

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Assuming now that the presence of glucose in the urine has been definitely established. The next step in investigation is to establish whether or no "the iron reaction" is positive. If positive, the presence of one or all of acetone, diacetic acid and β -oxybutyric acid is indicated. A positive reaction is the formation of a blood-red colour when the ferric chloride solution is added *in excess*. An exactly similar colour may be produced by the urine of a patient who has been given a drug belonging to the salicylate group, but in the latter case thorough boiling does not abolish, but rather tends to deepen the colour; on the other hand, if the colour is due to the presence of one of the acetone bodies, it will disappear, or at least be reduced, as these bodies are volatilised. The ferric chloride test is quite suitable for clinical purposes, but should a special test for acetone be required the following may be employed:

A few drops of a freshly prepared saturated solution of sodium nitroprusside are added to a third of a test-tube full of urine with sufficient solution of liquor potassæ to make the mixture alkaline. A ruby-red or amethyst colour which becomes deeper on the addition of glacial acetic acid indicates the presence of acetone. It should be noted that the iron reaction merely indicates "acidosis," and may be present in any condition when carbohydrate food is not being adequately utilised. So that in addition to diabetes mellitus, its presence may be expected in starvation when carbohydrate is not being ingested, in persistent vomiting when it is not being retained, and in diarrhœa when it is not being absorbed. But, naturally, in none of these circumstances would glycosuria be present.

In any case of glycosuria it is of vital importance that the patient should be tested for hyper-glycæmia, the presence of an excessive quantity of sugar in the

blood. Normally, blood contains 0·1 % sugar; in diabetes mellitus from 0·2 to 0·4 % may be encountered. The method of estimation need not be described, requiring as it does a thoroughly well-equipped laboratory and frequent practice to ensure accurate technique. The same considerations apply to special tests for confirmatory evidence of pancreatic disease, which is usually the concomitant of diabetes mellitus.

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In a contribution specially devoted to diseases of the urinary organs and abnormalities of the urine it is sufficient to have considered the practical importance of the phenomenon, glycosuria, but any details as to treatment would be quite out of place. The disease, diabetes mellitus, is, speaking generally, a disturbance of the internal secretion of the pancreas, and has no particular pathological connection with the organs of micturition. Quite apart from this circumstance, the elaborate details of the modern method of treatment could not possibly be sketched in this small work, and special text-books should be consulted.

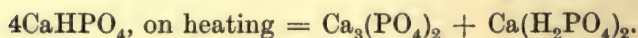
CHAPTER VI

OTHER CHANGES IN THE URINE DUE TO DEFECTIVE METABOLISM

Phosphaturia.

It is doubtful if this condition has any real pathological importance, although it is usually identified with a person of nervous disposition and is popularly regarded as evidence of excessive wear and tear of the nervous system. How far this is so is doubtful, and whether some error of metabolism is present is equally a matter of opinion; but there is at least no doubt that phosphaturia in greater or less degree is exceedingly frequent in the neurotic and those suffering from functional disorders. Not infrequently the cloudy appearance to the urine which a quantity of phosphates may impart is a matter of alarm to a patient who interrogates his doctor accordingly, more especially as the sufferer is the type of person particularly prone to be morbidly observant as to peculiarities of his excreta.

Clinically, the importance to the physician lies in distinguishing phosphaturia from albuminuria (or pyuria). A very simple test suffices. Phosphates of calcium and magnesium are precipitated by heat in alkaline urine, but the precipitate (unlike that of coagulated albumin) at once disappears on the addition of dilute acetic acid.



The former precipitates out, but is very soluble in acid. After a big meal requiring an increased quantity of

acid in the stomach, there is relatively a superabundance of bases set free, so that the monohydric phosphate exceeds the dihydrogen phosphate salt, and being less soluble precipitates out in the urine as small needle-like crystals.

The triple phosphates of ammonium and magnesium may be produced by the ammoniacal decomposition of urea, and be recognised as knife-rest or coffin-lid shaped crystals.

The method of recognising phosphaturia has been described. Whether or no any form of treatment might result in its disappearance it is certainly a condition which does not call for treatment other than reassurance of a patient who has himself observed the peculiarity.

Oxaluria.

Oxalates appear in the urine in the shape of envelope crystals. Their presence is detected microscopically. When occurring in small quantities they cannot be regarded as pathological, and even when in comparatively large quantities they denote merely a peculiarity of metabolism—on the border-line of pathology—akin to phosphaturia, which is considered above. Once again the nervous system has been invoked as a causal or at least an associated factor, and it is by no means unusual for phosphaturia and oxaluria to alternate in the same person.

Oxalates may be both endogenous and exogenous. In the former case their presence is due to synthetic production; in the latter, to oxalic acid yielding substances in certain foods, particularly rhubarb, spinach and tomatoes, are responsible. Oxaluria is clinically of far greater importance than phosphaturia. Hæmaturia may be produced, and the existence of a renal or vesical calculus may be in question. In many

of such cases irritation of the renal substance by the crystals alone may be the cause of the hæmorrhage, and no aggregation is in existence. But naturally, should there be clinical evidence of stone (see page 114), the microscopical discovery of the typical crystals in the urine would be a valuable piece of confirmatory evidence.

Persons with the "oxalic acid diathesis" will be wise to avoid those foodstuffs which are rich in oxalic acid yielding substances; to avoid conditions which may lead to concentration of the urine; and to keep the kidneys well flushed by drinking bland fluids, as otherwise in the course of time sufficient collection to constitute a calculus may occur.

Clinically, oxaluria is also of importance in being credited with the production of enuresis in children. This subject is treated in detail at page 50, and although oxaluria is on the whole an unimportant factor in this connection, such an element might well be potent in initiating and perpetuating the disability in a predisposed subject.

Chyluria.

A milky appearance of the urine may be due merely to a large excess of phosphates spontaneously deposited. This condition is easily definable by the addition of dilute acetic acid, which instantly clears up the turbidity. But a rare condition of milky urine known as chyluria is due to the suspension of finely divided droplets of fat, which are not soluble in acetic acid (but soluble in ether), and the nature of which is at once clear on microscopical examination, especially if a drop or two of the familiar stains for fat, osmic acid or Sudan III, are added.

The commonest cause of this condition is infection by the *Filaria sanguinis hominis*. Diagnosis is absolutely

made by identification of the parasite in the blood examined at an appropriate period, although this is not always easily discovered, and as evidence in support may be mentioned the existence of elephantiasis and the presence of an excess of eosinophil cells in the blood.

A non-parasitic cause of chyluria is also possible. In such cases blocking of the lymphatics must occur by pressure upon the thoracic duct, usually by secondary malignant glands.

Choluria.

Urine containing bile has usually a characteristic appearance. Although the exact degree of coloration is variable, a yellowish-green iridescent element is always present, and on shaking the urine in a test-tube closed with cotton-wool, foam is readily formed and stains the cotton-wool yellow. Tests for bile depend on reactions with bile salts or bile pigments. The quickest and simplest test is to employ a 1% alcoholic solution of iodine and add an equal quantity of urine, diluted if necessary: an olive-green colour is a positive reaction. The test may also be performed by pouring the iodine solution gently on to the surface of the urine, when a green ring will be formed at the junction.

Gmelin's test relates to bile pigments. Fuming nitric acid (i.e. containing nitrous acid) is the reagent, and this may be added to the urine in a variety of ways. It may be poured carefully on to the surface of the urine in a test-tube, or better still the urine may be allowed to flow from a pipette upon the surface of the reagent, the test-tube being held in a slanting position. Alternatively, a drop of the reagent may be brought into contact with a drop of urine on a porcelain slab or a piece of white blotting or filter paper. A positive reaction is a play of colours at the junction, yellow

changing to red, then to purple and blue, and finally to green, the last named being the essential feature in the test, the formation of biliverdin.

Pettenkoffer's test is due to the presence of bile salts. The reagents are cane sugar and concentrated sulphuric acid. A reddish-purple or deep purple colour is a positive reaction.

Hay's test depends upon the reduction of surface tension through the presence of bile salts, and is performed by sprinkling flowers of sulphur on the surface of the urine. If bile is present, the sulphur particles sink through the fluid instead of remaining on the surface.

For clinical purposes it is quite sufficient to employ the iodine test to determine the presence of bile.

Urinary Deposits.

A large variety of crystalline and amorphous substances may be identified in the microscopical examination of urine under various conditions: Some are relatively very rare and associated only with uncommon disorders of metabolism. The following include the substances most commonly encountered:

Urea may precipitate out in very concentrated urine in the form of rhombic prismatic crystals. These are themselves white, but they almost invariably carry down with them in their precipitation uroerythrin, the pigment of urine which imparts a pink colour.

(*Urea* is present in urine normally to the extent of 2 % to 3 %, and in the blood from 0.3 to 0.1 %.)

Uric Acid.—Under certain conditions this is displaced from its combinations and crystallises out of the urine either in the calices of the kidneys, in the bladder, or after the urine is voided. The crystals may be recognised as of the shape of a whetstone or of a barrel and agglomerated in masses: dumb-bell shapes are less frequent.

The presence of pigment (urochrome) imparts a pale yellow or yellow-brown colour, which in bulk gives the "cayenne pepper" appearance to the naked eye.

Identification of these crystals in urine is evidence in support of the diagnosis of calculus in a patient who has had renal colic, hæmaturia and suggestive pain referred from the kidney, ureter or bladder. In such a case microscopical examination would probably show blood cells, and epithelium cells as well as the crystals.

Precipitation of uric acid in the urine does not necessarily mean excess either in the tissues or the urine, but depends upon the absolute and relative proportions of phosphates and chlorides to uric acid and the absolute and relative amounts of bases present in the urine. Its origin is both exogenous from foods rich in nucleo-proteins and purins, and endogenous, the result of the subject's own metabolism. Its presence in large amount—normally with a mixed diet 0.025 to 0.065 % is excreted—denotes that the metabolism of urea is arrested at the uric acid stage. It would not be feasible to dwell in detail upon its relation to gout. Many gouty persons pass no excess of uric acid, although an excess is present as a rule in gout, as well as in the conditions leukæmia and pernicious anæmia and in a variety of other diseases.

Triple phosphates (of ammonium and magnesium) are usually transparent colourless prisms with bevelled edges.

Earthy phosphates (of calcium or magnesium) appear as a colourless amorphous deposit.

Oxalate of lime usually appears in the form of "envelope" crystals, the actual structure being an octahedron, which viewed from above yields the familiar appearance owing to the octahedral angles crossing the quadrilateral outline diagonally. Other less common shapes are also

seen, e.g. dumb-bell or hour-glass or as thin plates with rounded ends.

The *epithelial cells* derived from various parts of the urinary tract display the characteristic appearances of the organ from which they arise, e.g. the cubical and columnar cells from the kidney, the large flat cuboid cells from the bladder. A small quantity of the latter is not an evidence of a pathological condition; a large quantity denotes catarrh or inflammation.

Pneumaturia.

This rare peculiarity, gas in the urine, may arise in one of two ways, viz.:

(1) In consequence of a fistulous communication of the bladder with some part of the alimentary canal, most commonly the rectum.

(2) Through production of gas in the urine itself.

(a) Fermentation may occur in the bladder of sugar-containing urine in diabetes by the action of yeast and the consequent evolution of CO_2 , or by bacteria, when both hydrogen and CO_2 may be formed.

(b) In the case of non-saccharine urine by infection of the urinary tract by some gas-producing organism, e.g. *Bacillus coli communis*, or *B. lactis aërogenes*. In addition to CO_2 and hydrogen, marsh gas, nitrogen and sulphuretted hydrogen may be produced.

The presence of a recto-vesical fistula could hardly be overlooked, even if the fistula were not sufficiently large to cause the passage of fæces per urethram. An appropriate examination of the urine (bacteriological if necessary) will readily explain the phenomenon in the other cases referred to.

Treatment will obviously be that of the cause itself.

CHAPTER VII

ABNORMALITIES OF MICTURITION

NORMAL urination is of course a painless process necessitated periodically by a feeling of abdominal discomfort arising from distension of the bladder, which discomfort may become an acute pain if for any reason the desire to empty the bladder cannot be fulfilled. Whilst wide variations occur according to the amount of fluid ingested, the quantity of exercise taken, the activity of the skin, and, we may add, the degree of vesical distension to which an individual becomes habituated, the act of micturition occurs on an average five times in the twenty-four hours, so that from 8 to 10 ounces are normally voided on each occasion.

Considered as subjective symptoms, the following abnormalities of micturition occur :

- (1) Frequency.
- (2) Difficulty.
- (3) Pain.
- (4) Peculiarities in the stream.
- (5) Sudden stoppage of the flow.
- (6) Precipitancy.
- (7) Retention or absolute incapacity to micturate.
- (8) Incontinence.

Suppression, though it must receive consideration, is not, of course, a disorder of micturition, but of urinary secretion.

Frequency.

It is necessary to postulate here two distinct conditions : viz. increase in the number of times that micturition is performed and increase in the total quantity of urine passed. The former condition is

correctly designated *pollakiuria*, the latter is true *polyuria*. Polyuria is generally, although not invariably, associated with pollakiuria, either in actual if unobserved fact, or as an obvious subjective symptom: pollakiuria may or may not be associated with polyuria, e.g. the act of micturition may be performed several times in an hour, but only a few drops may be expelled on each occasion in such conditions as stricture or enlarged prostate. Frequency without polyuria is sometimes seen in early tuberculosis of the bladder.

It is manifest that in any condition of increased frequency the total quantity of urine passed in twenty-four hours must come under review in order to exclude the possibility of the symptom being due to increased secretion of urine which occurs in a number of conditions. These are best considered at this stage before dealing with genuine increased frequency.

Polyuria.—Polyuria may be encountered as a temporary or transient phenomenon of no pathological importance, and often attributable to an obvious cause. Thus, after the ingestion of large quantities of liquid the passage of a correspondingly large amount of urine of low specific gravity is to be expected. Incidentally we must note that the polydipsia may itself be the result of thirst induced by diabetes insipidus.

The association of copious micturition with nervous disorders of a functional character is a very familiar one. Thus the candidate for an examination, the applicant for life insurance, the nervous orator, the athlete just previous to a contest, exhibit the influence of an ordeal upon the secretion of urine and the desire to micturate. Nervous disorders which, although functional in character, possess certain features of organic disability, and which again are frequently accompanied by the passage of increased quantities of urine, are exemplified by attacks of spasmodic asthma, of angina pectoris, and of major epilepsy. In hysteria,

too, very large quantities of urine may be passed, and an attack of paroxysmal tachycardia is frequently terminated by the same phenomenon, which is also encountered at the crisis of fevers. Finally, transient polyuria may be accounted for by the ingestion of an exceptional quantity of some substance with diuretic properties, e.g. caffeine or theine and alcoholic beverages. Sudden changes in the atmospheric temperature are in certain susceptible people similarly effective.

In some diseased conditions of the heart or liver associated with anasarca, improvement of the functions of the diseased organ may be accompanied by a pronounced polyuria corresponding to the expulsion from the body of the fluid which had accumulated in the tissues and cavities. Thus a patient recently under the care of one of us suffering from myocardial degeneration and auricular fibrillation had extensive dropsy. He responded to rest and the action of digitalis, so that on the fourth day after the treatment was instituted he passed 70 ounces of urine (35 ounces on the previous day). On the fifth day he passed 110 ounces, on the sixth day 190 ounces, and on the seventh day 210 ounces. By this time the œdema had completely disappeared.

The periodic evacuation of a hydronephrosis may account for transient polyuria, the diagnosis of which, apart from pyelography, could only be determined by the correlated condition of a tumour disappearing with the passage of the increased quantity of urine.

To turn now to polyuria of continued character: it is encountered, first, in chronic inebriates. Just as an occasional polydipsia leads to a temporary polyuria, so the regular imbibition of large quantities of fluid leads to a regular polyuria, especially as in addition the persistent diuretic action of alcohol comes into play, and, after a time, the effect upon the kidneys may be the production of an interstitial nephritis,

Polyuria is the rule in contracted kidney of whatever origin. This condition is treated as a whole at page 74.

Polyuria is the rule in diabetes, whether of the type of insipidus or mellitus. In the former, enormous quantities of urine, even up to as much as 20 pints in the twenty-four hours, are not an unusual feature. Some types of diabetes insipidus are dependent upon pituitary disturbance, and most diseases of the pituitary body, e.g. acromegaly, are accompanied by polyuria. Indeed, this symptom not infrequently aids a diagnosis of dyspituitarism, which may have been suggested by general symptoms, but not of an unmistakable character. It is hardly necessary to add that so characteristic a condition as acromegaly requires no such diagnostic aid as a mere suggestive feature such as polyuria. The inter-relation of the ductless glands prepares us to expect polyuria in thyroid insufficiency, the compensatory overaction of the pituitary resulting in this symptom.

Finally, large quantities of urine are generally secreted in lardaceous and cystic disease of the kidney.

Diabetes Insipidus.—As reference has been made to this condition, it will be as well to include at this stage the few words which may be regarded as appropriate in a work of this nature. It is not always easy to distinguish mild degrees of what might without hesitation be described as diabetes insipidus from a polyuria, which, whilst overstepping the boundary of normality, can hardly be regarded as pathological. When as much as 10 pints of urine are passed in twenty-four hours, no hesitation need of course occur in labelling the condition which appears to be an incompetence of the kidneys to secrete urine of normal concentration. Differentiation may be afforded by the simple expedient of administering 20 grains of sodium chloride, which will ordinarily be followed by

an increase in concentration, but not in any increase in the quantity of urine passed. In true diabetes insipidus, on the other hand, the concentration remains unchanged, but the quantity of urine is increased. For this reason there is no justification in withholding fluid which leads merely to desiccation of the tissues, since the organism must at any cost obtain water sufficiently to reduce the concentration of urine.

Some cases of diabetes insipidus appear to depend upon syphilitic disease of the meninges at the base of the brain. In these, anti-syphilitic treatment is beneficial. Such treatment is of no service in other cases due to primary defect of the kidney with inability to secrete urine of normal concentration, nor in those for which disease of the pituitary is responsible. Pituitary extract has been recommended for the latter : in three cases so treated by one of the present authors no improvement was apparent, and in one of these cases intermittent attacks of glycosuria were present, indicating some relationship between the conditions of diabetes insipidus and mellitus.

To turn now to cases where the total amount of urine passed is not excessive, but in which there is genuine increased frequency : as one would have expected, it is in affections of the bladder and prostate that this symptom is most often encountered, but increased frequency is also a familiar concomitant of renal disease, the bladder being in a perfectly healthy state.

In the investigation of such a case the first care is to compare the nocturnal with the diurnal frequency. As a rule, the former predominates, as is particularly evident in cystitis and prostatitis, as well as in chronic interstitial nephritis (when increased secretion also occurs). In vesical calculus, diurnal frequency tends to predominate unless cystitis is also present. In carcinoma of the bladder, frequency has no particular time-relationship.

It must be pointed out that increased frequency is often the first, and for some time the only, symptom of commencing hypertrophy of the prostate and also of renal disease, particularly tuberculosis and interstitial nephritis. When no abnormality of the urine is present to point directly to an explanatory lesion, the cause of such a symptom often calls for considerable investigation.

In children, a local condition is generally the cause, e.g. phimosis or a congenitally small meatus. Threadworms by reflex irritation from the rectum, and balanitis also as a reflex irritation, are to be included in this category. Appropriate treatment of any of these conditions leads to speedy amelioration. If, in a child, any such local cause can be excluded, some abnormality of the urine should be suspected, e.g. the presence of *Bacillus coli communis* or of oxalates, or even of excessive acidity.

In an adult the commonest cause of increased frequency is cystitis, for which a large variety of causes may be responsible. The reader is referred to Chapter XIII.

Incontinence of Urine.

In infants, periodic reflex micturition independent of volition is invariable: at fairly regular intervals the bladder contracts automatically. With training, this act becomes influenced by the higher centres until control is established, when micturition becomes a voluntary act which involves contraction of the abdominal muscles to raise intravesical tension sufficiently to start the reflex process which is under the sway of the lumbar centre in the spinal cord.

Voluntary control presupposes a condition of mental stability first to learn to associate the process of micturition with certain circumstances, and later to understand social obligations. In the large majority of infants this control is fairly easily accomplished, and

such elementary education is, as is well known, possible also in the case of domestic animals. The degree of intelligence demanded is a comparatively low one ; so that although " dirtiness of habits " is a stigma frequently encountered in subjects of congenital mental deficiency, it is not impossible to train a child to cleanliness in this respect even if any form of academic education is impossible.

On the other hand, quite apart from the basal intelligence, this controlling influence of the higher centres appears to be of a special character. In some children it is established later than in others, just as some children are slow in learning to speak ; the co-ordination is more slowly acquired. Since control is usually established by the age of two, the term " enuresis " is applied to those cases in which bed-wetting occurs after this age in spite of special training having been undertaken. Such cases appear to possess either a micturition centre in a hyper-excitable state, liable to be stimulated by impulses which in a normal person would be resisted, or higher centres which on unduly slight provocation are prone to send out impulses to relax the compressor urethræ. Since the dominating influence of the higher centres is more likely to be in abeyance during sleep, nocturnal incontinence is relatively much more common than diurnal incontinence.

Most cases of enuresis are a persistence of the infantile condition, but it is not uncommon for this symptom to manifest itself between the ages of five and eight, the period of the second dentition, when nervous instability is likely to exert its influence as in the somewhat similar condition, stammering, another example of inco-ordination. So that apart from those cases of idiots who are mentally incapable of training, the candidate for enuresis is the fundamentally " nervy," over-excitable child. Unlike stammerers, however, boys do not preponderate, for the disability occurs

on the whole equally in the sexes. Dr. Still quotes of 200 cases that 102 were boys and 98 girls—and this notwithstanding the existence in the male of more opportunities for reflex stimuli to micturition so often vaunted as exciting causes.

The first care of the practitioner confronted with a case of enuresis is the exclusion of local causes, which may be an important item in the perpetuation of the condition. In passing, one may mention the possible existence of such congenital defects as epispadias or hypospadias, or even of a healed spina bifida, in which through involvement of the sphincter branch of the long pudic nerve incontinence of an *incurable* character may be present. But in connection with local causes reference may be made to rectal threadworms, vulvitis, a tight fore-skin, a pin-hole meatus, balanitis and pathological conditions of the urine (e.g. oxaluria). Dr. Still is sceptical as to the direct influence of the commoner reflex causes ; he is rather disposed to minimise the likelihood of direct reflex action, but to suppose that such causes tend to set up a general increase of nervous irritability in a child already predisposed. This, of course, does not deny the value of their elimination, but merely emphasises what is undoubtedly the case, that the most important condition is the basic temperament. For similar reasons the influence of adenoids must not be too enthusiastically accepted. Their removal improves the general health, and has often a high psychical value ; their removal, then, is only one element in the treatment of the case.

An obvious precaution to be adopted is the avoidance of any fluid two hours before bed-time. But this should not encourage too wholesale a restriction of liquid throughout the day, so causing a concentration of the urine, which is thereby rendered more irritating, and so likely to contribute to incontinence. Foodstuffs of a diuretic character, and those of strong or highly

spiced flavours, or with excess of salt, are equally to be avoided. The urine and urinary tract should be examined for evidence of cystitis, of vesical calculus, or of pyelitis. (Cystoscopy can be performed after the age of five with reasonable ease.) It is well to remember that the polyuria of diabetes (mellitus and insipidus) has been frequently overlooked, and cases diagnosed as "enuresis," when the failure of control may really be due to the rapid filling of the bladder. Even the possibility of organic disease of the brain and spinal cord should receive at least passing consideration as a possible factor.

But, after all, the very great majority of cases fall into the category of want of co-ordination, of "weak" or "irritable bladder," so that, when all subsidiary forms of treatment have been completed, a definite attack upon the nervous system is necessary in the direction of special training towards periodic micturition.

The first step is to establish a degree of confidence resulting from a sympathetic reception of the disability. Not infrequently the little boy has already been subjected to various methods of influence, ranging from promises and bribes, to threats, ridicule, and similar persecutions. An "anxiety neurosis" is very easily established if too much attention is brought to bear upon the condition, and even simple neglect in the hope that time alone will effect a cure is to be preferred to the encouragement of an introspection. The realisation that it is of profound importance to produce a rapid cure of a condition which is causing the sufferer's parents much perturbation as to the future is quite sufficient to perpetuate the catastrophe, every repetition of which makes the subject more resistant to treatment.

At first, elementary methods of training may be tried and found efficient. The child should be awakened every two hours in the night in order to empty his bladder. Gradually these intervals are made longer

and longer, until eventually the bladder can tolerate a normal degree of distension. Such a process of training is best conducted away from the patient's own home, since the necessary discipline is far more easily enforced, whilst the psychical stimulus of an entirely strange environment is a very potent factor. The circumstance that nocturnal incontinence is so much more common than diurnal incontinence has encouraged psycho-pathologists to the view that the act of involuntary micturition has a sexual basis of the nature of a vicarious seminal pollution, and calls for psychical treatment of a special character. With this view we have no concern.

It is by no means without question that such forms of treatment as intra-vesical electricity may not act by the suggestive effect they produce rather than by any actual organic influence. Some time ago an American investigator upon local anæsthesia for operation upon the rectum, which consisted in injecting, not into the spinal canal, but in the vicinity of the cauda equina, stated his faith in this procedure for the successful treatment of nocturnal incontinence. But it is very doubtful if any local action really occurs, for it has long been observed that cure of enuresis may follow *any* operation, and *à fortiori* if the operation is related to the bladder, e.g. cystoscopy. Such methods as intra-vesical electricity or the application of caustics may in all probability act only by their psychical influence, which can be just as easily produced without the infliction of suffering.

We have used the term "anxiety neurosis" as likely to perpetuate the condition. A neurosis of another character may be established, as in a case recently seen by one of us in which the incontinence took the form of a "defence neurosis." A sympathetic conversation revealed the circumstance that the boy had been ill-treated at school, and had developed

this "defence neurosis" in order to save himself the ordeal of further attendance, which was precluded by the existence of this symptom. This case is mentioned merely to point out that in a highly susceptible person a neurosis may be set up, the germinating cause of which may be comparatively easily detected by anyone acquainted with the ordinary circumstances of a boy's life and the possibilities which may arise therefrom. Whether psycho-analysis might prove of value in more obstinate cases said to demand such analytical investigation we do not feel competent to express an opinion.

Turning now to the use of drugs. Many have been recommended for their specific effect, but it does not appear that any one has a really selective action. On the contrary, it is the experience of all physicians accustomed to treat such cases that success with one may result after total failure of all others to produce any improvement, whilst in another case an entirely different drug leads to success. Belladonna is the drug most likely to do good, and it should be administered in large doses—children tolerate it well—up to as much as 10 or 12 minims of the tincture three times a day for a child of five. The liquid extract of *Rhus aromatica*, thyroid extract, *nux vomica*, ergot, phenazonum and the bromides, are other drugs which have gained a reputation, and any one of these may prove to be the most serviceable for any individual case.

* * * * *

Incontinence arising in adult life must be separated into two conditions, viz. true incontinence, in which urine dribbles as fast as it enters the bladder, and "false incontinence," which is due to distension of the bladder, and in which the incontinence is of the nature of an overflow. The former is necessarily due to paralysis of the vesical sphincter; the latter is associated with some mechanical obstruction, particularly

an enlarged prostate, when the over-distended bladder has finally become flaccid and atonic. (See Ch. XV.)

In tabes, true dribbling may occur from anæsthesia of the bladder. Nocturnal incontinence is a common preliminary. By the time urinary symptoms are present the familiar concomitants of Argyll-Robertson pupils and absence of reflexes should be also present. The cystoscopic appearance is typical. The bladder wall exhibits changes unlike any other lesion but primary atony. As a rule the incontinence is intractable, however rigorously the parasyphilitic condition is treated, and the patient is compelled to wear a portable rubber apparatus, or a De Pezzer tube is inserted. (See Chapter XV.) In disseminated sclerosis and other diseases of the spinal cord and cauda equina, dribbling may result from flaccidity of the bladder and atony of the sphincter.

In transverse lesions of the spinal cord the first effect upon the bladder is that of retention of urine from contraction of the internal sphincter. Should this distension be neglected, overflow incontinence will ultimately result, and the same condition will occur in coma when accumulation of urine has been permitted. But if, as is usually the case, regular catheterisation is undertaken, the bladder recovers its contractile power, and as Riddoch and Head have pointed out (*Brain*, 1918, vol xl., pp. 149-263, and the *Lancet*, December 21, 1918, p. 839), the "primitive mass reflex" of the infant reappears, so that contraction of the bladder can be elicited by cutaneous stimulation of the thigh, and a paraplegic patient can in this way utilise his reflex incontinence to empty his bladder when it has reached a sufficient degree of distension.

It may be added that true incontinence does not occur in hysteria, although frequency combined with carelessness may result in a state of perpetual wetness which may be mistaken for actual incontinence.

If urethral stricture is the cause of incontinence, there

will be a history of progressive difficulty and the passage of a small stream. The lesion is demonstrated by the passage of bougies and by urethroscopy. (See Ch. XVI.)

Primary atony of the bladder appears between the ages of twenty-five and forty. The cause has not been discovered: there is no evidence of organic nervous disease, although cystoscopically a similarity is presented to the appearance of the tabetic bladder. The disease is progressive, and from partial loss of control eventually micturition becomes completely involuntary.

Incontinence in Women.—The preceding causes for adult incontinence must be supplemented in the case of women by special causes incidental to parturition, during which injury may be caused to the compressor urethræ by pressure of the foetal head, or actual tearing of the peri-urethral tissues may result. The condition of prolapse, too, may be responsible for some degree of incontinence, which will naturally be aggravated by increase of intra-abdominal pressure, as in sneezing or coughing or violent exertion, and when an abdominal tumour develops, e.g. in pregnancy or pathologically. Such conditions of partial incontinence vary from a trivial discomfort increased by nervousness or morbid anticipation up to a considerable degree of disability demanding the use of a portable urinal. Local contributory causes such as prolapse must receive appropriate treatment.

Marion has devised an operation for the cure of incontinence in women for which he claims considerable success.

Difficulty in Micturition.

Difficult and painful micturition are frequent concomitants, but either may be present independently of the other, although, naturally, confusion in the patient's mind as regards these two distinctly different sensations is likely to arise, and may be dissociated only by detailed cross-examination.

Difficulty in micturition must necessarily involve a mechanical cause, either obstruction to the passage of the urinary flow or interference with the nervous mechanism which governs the act of micturition. Obstruction in the urethra is far more frequent in the male. In this sex, stricture is a common sequela of gonorrhœa, and is the commonest cause of difficulty in micturition. In the female, stricture (from gonorrhœa) is very rare. Similarly, the less frequent but well recognised form of difficulty arising from calculus impacted in the urethra so as partially to obstruct it, is almost entirely restricted to the male.

Thirdly, prostatic disease (whether simple hypertrophy, carcinomatous enlargement, or inflammatory change) is of course restricted to the male. Here again a mechanical obstruction to urination results—see the detailed consideration of prostatic disease, page 15. In the female, occlusion of the urethra arises in an entirely different fashion, viz. from dragging and pressure of a pelvic tumour, most frequently a fibroid or a retroverted gravid uterus. Such conditions are diagnosable by routine pelvic examination, which is naturally undertaken in any disorder of micturition in the female. Partial occlusion of the urethra may also occur by extension into its walls of a carcinomatous mass in the vagina.

Turning now to the bladder. The prostate has already been considered; other vesical causes are common to both sexes. The vesical orifice of the urethra may become occluded by blood-clot after an extensive hæmorrhage from the bladder mucous membrane. An infiltrating growth of the bladder may eventually extend into and obstruct the urethral orifice, but in both these conditions retention of urine rather than difficulty only is likely to arise (*q.v.*).

The diseases of the nervous system associated with difficulty in micturition are tabes and transverse myelitis. In the latter the innervation of the bladder

itself may be cut off, so that urination is impossible : in the former difficulty may be experienced in various ways, although actual control of the act may not be lost. In disseminated sclerosis, a special form of difficulty known as stammering micturition is sometimes encountered.

Difficulty in micturition of a purely functional character is not unknown. From interference with its sympathetic nerve-supply, a condition of atony of the bladder may result ; whilst the psychical difficulty experienced by nervous individuals who are requested to micturate for the special purpose of examination is too familiar to need further mention. (See also Retention of Urine, which more particularly applies in this consideration.)

Painful Micturition.

Excluding conditions of peritoneal inflammation in which pain is felt locally upon emptying the bladder on account of the tension upon the peritoneum, pain on micturition always results from some disease of the urinary tract, or some pathological state of the urine itself. The last named as a possible cause can be rapidly dismissed. In a few instances a hyperacidity of the urine may cause a stabbing pain along the urethra during the act of micturition and for a short time afterwards. In cases where a large number of oxalate crystals are being passed in a concentrated urine the friction against the urethral mucous membrane may lead to the same sort of painful sensation.

Pain in the urethra during micturition is in the male most frequently due to acute inflammation, especially gonorrhœa in the first few days of an attack. Rarer forms of urethritis of non-venereal character may occur, but clinically their occurrence is overshadowed by the far greater preponderance of gonococcal infection.

In the female, painful urethritis is less frequent,

and when it occurs is not of so intense a character. Urethral pain on micturition in the female is generally due to the existence of a caruncle.

Pain experienced immediately after micturition and referred to the tip of the penis is traditionally identified with vesical calculus, but it may arise from any condition in which there is inflammation of the trigone of the bladder, e.g. cystitis, prostatitis, malignant disease, as well as calculus.

As a rare cause of this sort of pain must be mentioned a calculus impacted at the vesical end of a ureter.

Pain during micturition may be referred not to the urethra, but to the perineum, as a peculiar dragging sensation felt after as well as during the passage of urine. Prostatic disease should be suspected in such a symptom, although it is also encountered in vesical carcinoma.

Oliguria : Suppression of Urine.

Reduction in the quantity of urine secreted is encountered as a physiological phenomenon as well as in pathological conditions of the urinary organs. When secretion becomes reduced to a minimum so that insufficient collects to distend the bladder to a degree which excites the normal reflex of micturition, the condition known as suppression occurs, although it must be added that suppression may have a purely mechanical cause (*vide infra*).

Oliguria is present in most febrile states. The secretion, too, is proportionately reduced whenever there is loss of fluid from the body in other ways, as for example in persistent diarrhoea and vomiting. The same effect is produced if whilst the fluid is not actually lost from the body it accumulates under the skin or in the body cavities, as in ascites or hydrothorax. The secretion of urine may be much reduced in cardiac failure and in any condition accompanied by a low blood-pressure.

The commonest pathological condition in which oliguria is a feature is acute Bright's disease (*q.v.* page 71).

When true suppression occurs the bladder will naturally be found empty when a catheter is passed. Any mechanical obstruction leading to suppression must be on the proximal side of the bladder, as e.g. a carcinomatous growth of the bladder extending into and blocking the ureteral orifices. Such a condition of suppression will almost certainly be preceded by evidence of malignant disease of the bladder, e.g. frequency and pain on micturition, hæmaturia and pyuria. Cystoscopic examination will reveal the growth in situ, whilst a rectal or pelvic examination will lead to the discovery that the base of the bladder is infiltrated.

Similarly, double calculus of the kidney might produce the same effect at the upper openings of the ureters. This occurrence, though possible, is rare; more frequently the anuria results from blockage of the ureter of a solitary functional kidney. It follows, too, that anuria would result from removal of a kidney when the remaining organ was functionally impaired, for which reason surgeons are always at pains to ascertain that the other kidney is functioning satisfactorily before the performance of a nephrectomy. One kidney, too, might be congenitally absent.

As non-obstructive causes of suppression must first be mentioned the possibility of simulation in hysteria and in deliberate malingering when it has been maintained that no urine has been passed. The bladder may be empty at the time of examination, but if a careful watch on the subject be kept and surreptitious micturition made impossible, it will be found that the bladder fills in the usual way.

A somewhat alarming suppression occasionally follows an abdominal operation as a reflex phenomenon; and unless it is realised that such a condition is by no means unfamiliar, considerable perturbation may

be excited. It calls for no active treatment other than cupping or hot applications to the loins. It must of course be distinguished from the *retention*, which, as is mentioned below, sometimes follows operations, especially herniotomy and appendicectomy.

Turning now to pathological conditions of the urinary organs, suppression is most commonly seen in such diseases of the kidney as acute nephritis, polycystic disease and pyelonephritis. It may also result from the ingestion of a poison, the excretion of which through the kidney excites inflammation and impairment or abolition of its function, e.g. cantharides, turpentine, mercury, phosphorus. In all circumstances such as these, and others when the kidney's normal activity is in abeyance, uræmia is imminent, and the characteristic phenomena of drowsiness, with headache, convulsions, dyspnœa and vomiting gradually develop. For further consideration of uræmia see page 73.

Anuria may follow the passage of a catheter to relieve a much over-distended bladder in cases where obstruction is of long standing and the kidneys have from back pressure become distended and septic. Such anuria is more likely to arise if the distension is very rapidly relieved, and to obviate such an occurrence care is always taken to empty the bladder *slowly* in such cases.

Retention of Urine.

This condition has already been distinguished from anuria—suppression of urine.

Retention may arise, as in the case of difficulty, from a mechanical cause, or from some disturbance of the nervous innervation. In this connection one may regard retention as due to a more extreme degree of a condition which in a less pronounced form causes difficulty. As commonest causes, then, of retention must again be mentioned urethral stricture and prostatic

enlargement. Complete occlusion of the urethra may result from an impacted calculus or from the free portion of a pedunculated tumour of the bladder having become washed into the vesical orifice by the urinary stream.

Nervous Causes of Retention.—Retention will result from interference with the spinal centre for micturition, as in compression paraplegia, or transverse myelitis of inflammatory or degenerative origin. The situation of the lesion will have an influence upon the condition, a difference resulting according as a portion of the cord above the lumbar centre for micturition or that portion which itself contains the centre is affected. In the latter, retention does not occur. (See Incontinence of Urine, page 56.)

Retention frequently arises reflexly after operations as an immediate (and temporary) condition, particularly in operations upon the rectum and for hernia, although it may ensue upon any laparotomy.

As a special cause of reflex retention may be instanced the voluntary retention as an instinctive defensive mechanism in any condition in which micturition is painful.

In neurotic persons, retention may quite spontaneously occur in the absence of any disease, from what is termed spasmodic contraction of the sphincter vesicæ. In such cases a catheter can be easily passed, with the aid of anæsthesia, and it is evident that the condition may be an active spasm as much as a defective relaxation of normal tonicity. A more correct term therefore would be *achalasia vesicæ*, analogous as it is to the “*œsophagismus*,” occasionally witnessed at the cardiac orifice of the stomach.

As a variety of retention, the peculiarity of sudden stoppage of the flow of urine has obvious causation. A small movable calculus in the urethra, which when impacted leads to retention, may become impacted

during the passage of a stream which began in normal fashion. A similar phenomenon is afforded by the sudden occlusion of the vesical orifice of the urethra by a villous tumour of the bladder. Again, the condition of achalasia above referred to may exhibit an intermittent activity with alternating intervals of normal flow and of retention. In the same way, nervousness when asked to urinate may not lead to absolute retention, but to a sudden termination of the flow after micturition has started.

Peculiarities in the Urinary Stream.

(1) In such developmental defects as hypospadias, epispadias, ectopia vesicæ, a normal urinary stream is of course impossible.

(2) In urethral stricture great variability in the character of the stream may be seen. It may be persistently small and of feeble projectile power; sometimes, in fact, no proper stream is ever passed, but the urine merely dribbles away. On the other hand, the bladder may hypertrophy at first to overcome the resistance, so that a very good stream may be passed. In such cases urgency is a prominent feature, and the patient suffers from what is known as *precipitate* micturition. On the whole, the typical history of stricture is of gradual and progressive narrowing, with increasing difficulty in micturition and feebleness of stream. (See Chapter XVI.)

(3) In prostatic disease. Changes in the stream are associated with difficulty in micturition and occasional retention.

(4) Nervous diseases. We have already referred to disorders of micturition due to defective innervation of the bladder, and no further description is necessary. Changes in the character of the stream are naturally associated with variations in vesical distension.

CHAPTER VIII

ESTIMATION OF THE RENAL FUNCTION

THE estimation of the renal efficiency, i.e. the selective capacity of the renal substance to pass or restrain various substances with their corresponding appearance in the urine, is of advantage both to the physician and the surgeon. The damage which the renal cortex has sustained by some infective or degenerative condition (so called "medical kidney") can be assessed to a degree upon which a prognosis can be accurately based.

In other conditions, such as urethral stricture or enlarged prostate, judgment as to the suitability of an operation may be influenced by similar tests which indicate how far the kidney has suffered from the lesion in the lower urinary tract.

Although inefficient action of the kidneys will produce extensive constitutional disturbances and alterations in the character of the urine, the clinical signs will more certainly demonstrate the true condition of the patient when supported by chemical evidence. Therefore, when studying the state of the kidney, it is necessary to consider (1) the general condition of the patient, (2) the changes in the urine, and (3) the result of certain chemical tests.

(1) The General Condition of the Patient.—When the kidney first fails to excrete a normal urine, the regular functions of other organs are disturbed.

Functional gastric disorders are to be expected. The appetite is impaired, the tongue is dry, and complaint of thirst is made. Flatulence is very

frequent, and vomiting occasional. The skin loses its elasticity and is abnormally dry.

In acute nephritis, the result of back-pressure, the complexion becomes muddy and sallow and the face slightly drawn. On the other hand, in chronic tubular nephritis the face is white and puffy. There is a gradual loss of energy, accompanied by headache and drowsiness. These changes are not to be noted at the same time, but the skilled clinician will be able to interpret their meaning in association with his other observations. Hiccough is a late sign of renal failure, and indicates a very grave condition. A persistent subnormal temperature is another disquieting phenomenon.

(2) Changes in the Urine.—Reference is made in another chapter (page 71) to the character of the urine in nephritis, and it will here suffice to emphasise the meaning of certain changes as indicative of the extent of the altered renal function.

The onset of renal failure is denoted by a polyuria, a urine of low specific gravity, with a trace of albumin and decreased urea excretion. A large quantity of albumin in the urine does not necessarily mean that the renal activity is failing unless it is associated with a failing urea excretion; but the decrease in the output of urea is sure evidence of extensive disease even when the urine is otherwise normal.

(3) Chemical Tests for Renal Efficiency.—The principle upon which the tests for renal efficiency depend is the administration of some inert substance which is excreted in the urine and can be conveniently identified and estimated both as regards the velocity and extent of its excretion. The substances used have been aniline dyes, such as indigo-carmin and methylene blue and phenol phthalein. By means of a colorimeter it is possible to detect how much dye has been excreted

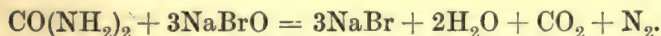
in the urine in a given time, but apart from their difficulty the above-mentioned tests are unreliable.

Another substance which has been employed is phloridzin, but it damages the renal tissue and increases its permeability for sugar, so that it is too variable to be of any value.

The estimation of urea in the blood is a valuable and accurate renal test, but is too complicated for anyone but a laboratory worker to perform.

The familiar estimation of urea in the urine can be recommended as one which does not make any great demand upon the time, or the laboratory resources, of a busy practitioner, and is yet productive of results which serve for all practical purposes. The sample of urine to be tested should be taken from the total passed in twenty-four hours. The normal percentage of urea excretion in twenty-four hours is on an average 2.2. A reduction to 1 % or under will denote inefficiency of the renal function. The sodium hypobromite test is recommended as the simplest.

The rationale depends upon the decomposition of urea by sodium hypobromite with the liberation of nitrogen, the estimation of which is proportional to the amount of urea—



Various pieces of apparatus are procurable, some of such convenience that from the volume of nitrogen formed the percentage of urea can be directly read off.

In practice a solution of sodium hydroxide is used, and bromine is separately added at the time of the experiment, since hypobromite solution itself is not stable. This is placed in a conveniently shaped flask, into which is carefully introduced a small test-tube containing 5 c.c. of the urine to be estimated. The flask is closed with a rubber stopper, through which

runs a piece of tubing connected up to a measuring-tube containing water, with suitable arrangement for its displacement. The measuring tube is filled with water, and when the apparatus is tightly closed the urine is allowed gradually to come into contact with the hypobromite solution by inclining the generating flask. Gentle agitation ensures the complete decomposition of the urea. The nitrogen forces down the column of water in the measuring-tube, the apparatus is left to cool, when the final reading of the displaced water column is read off after making suitable adjustment of the level. The volume of nitrogen is then read off, and from this the percentage of urea is either directly seen or calculated according to the above formula.

Recently Maclean has recommended that urea be given by the mouth previous to its estimation in the urine. Fifteen grams of urea are dissolved in 100 c.c. of distilled water flavoured with tincture of orange. This solution is taken on an empty stomach, preferably on rising in the morning. The bladder should then be completely emptied. Two hours later the patient micturates, and the concentration of urea in the urine is determined. After an interval of another hour the urine is once more collected and the percentage of urea again estimated. If in both specimens it falls below 1·5, the renal function is considered to be below normal. If the first specimen gives a percentage below and the second above 1·5, the renal function is approximately normal.

This test is simple and can be performed by the busiest man : the results are satisfactory and rarely give misleading information.

The Diastase Test.—Diastase is absorbed from the intestine, and is normally excreted in the urine to a degree which is measured as 10 to 22·2 units. It is not necessary to explain the rationale of the estimation,

which consists briefly in using graduated dilutions of the urine, and ascertaining the most dilute which can still exert a diastatic action as measured by the conversion of starch into dextrin and maltose. Iodine is used as an indicator, and the production of the familiar blue coloration denotes that conversion has not occurred.

In nephritis the diastatic index is reduced to perhaps 5 units, or even lower, and this low value persists even after albumin may have disappeared from the urine.

It cannot be too often emphasised that these tests *per se* must not be the only guide to the condition of the kidneys. The picture is only complete when chemical tests, changes in the urine, and the general condition of the patient are placed in their proper perspective.

CHAPTER IX

NEPHRITIS

Acute Nephritis.

TYPICALLY, the onset is acute, and follows exposure to cold and wet or the ingestion of some substance irritating to the kidney, such as catharides or turpentine. The toxins in the diseases scarlet fever, diphtheria, and pneumonia and others already alluded to are similar irritants. The acute exacerbations which occur apparently spontaneously in subjects of chronic nephritis are also the result of some less virulent toxin, perhaps autogenous, which would not affect a kidney of normal structure and vitality.

Trench nephritis demands special mention. A large variety of ætiological causes have been suggested, such as the excessive protein diet on active service, the ingestion of particles of metal from the cooking utensils employed in the field, the unmasking through lowered vitality of a number of cases of previously existing but unrecognised nephritis. But without recounting the evidence contradictory of the above-mentioned hypotheses, or in favour of the one now generally held, trench nephritis has been shown to be a true acute nephritis in many respects closely resembling that of scarlatinal origin, in which susceptibility seems to play a part, and cold and exposure to be predisposing factors, but the actual cause of which is an infective agent, not a recognisable micro-organism but of ultra-microscopic type, or a toxin.

Characteristically, fever of variable degree with rigors and vomiting is present, and complaint may be

made of pain in the lumbar region or indistinctly localised in the abdomen. Œdema is often present, the face and ankles particularly being affected, but œdema is by no means invariable, and will especially be absent if the patient has already been confined to bed for some time suffering from one of the acute diseases with which nephritis is associated. In such cases only a routine examination of the urine would lead to the discovery of nephritis, since nothing symptomatic to point to an affection of the kidney may be present. In all probability, many such cases become overlooked, subsequently to manifest themselves as chronic nephritis. In the last influenza epidemic, nephritis was shown to be of very frequent occurrence, yet the typical symptoms of acute nephritis were not at all evident. Similarly, the occurrence of pyrexia with unaccountable dyspnœa, unaccountable that is to say in the absence of disease of the heart or lungs, may be the presenting condition.

The urine will be reduced to 12 ounces or even less in the twenty-four hours, and sometimes there is complete suppression. It is of high specific gravity. Its colour will be dark, either from concentration or from the admixture of blood the quantity of which will produce variations, from a light pink almost to blackness. Albumin is present often in considerable amount, urea is much reduced, and chlorides are diminished. On examining the deposit of a centrifugalised specimen microscopically, casts (hyaline, granular, epithelial), blood cells and epithelial cells are seen.

Hypertrophy of the heart and raised blood-pressure will be present if, as is frequently the case, an acute exacerbation has supervened upon a chronic condition. In a primary acute attack, arterial changes are not to be expected, but a history of some recent condition which suggests scarlet fever is a valuable aid in the diagnosis. Cases are sometimes sent to hospital as "acute nephritis," which are really a manifestation

of scarlet fever, and during their treatment in hospital a recurrence of the fever is not uncommon.

Pallor is often a marked early feature, with gradually increasing anæmia.

TREATMENT.—The treatment of acute nephritis falls under the following headings: First, directly to diminish the work thrown upon the kidneys, which will include the reduction of nitrogenous foodstuffs and of extractives. Since the production of œdema appears to be in some way associated with the retention of chlorides, salt in the food should be withheld as far as possible. The orthodox diet is 3 pints of milk daily, and, indeed, even this bland diet has objections, inasmuch as the albuminous constituent therein is considerable. Furthermore, the frequent occurrence of nausea and vomiting demands the avoidance of any but simple digestible foodstuffs. It may be well to restrict the nourishment in the acute stage to fruit juices, so that practically nothing but water and a little sugar are being taken. With improvement in the general condition and in the local condition, as demonstrated by the disappearance of casts and reduction of albumin in the urine, the diet can be gradually extended.

Secondly, indirectly to conserve the kidney, reducing its work by promoting and encouraging excretion through other channels, the bowels and the skin. To this end the passage of copious watery stools is ensured by the administration of hydragogue cathartics, of the type of pulvis jalapæ compositus, or of concentrated salines. The action of the skin is promoted by diaphoretics, such as liquor ammonii acetatis and spiritus ætheris nitrosi, and by the stimulating influence of the hot pack or the vapour bath, preferably the former. Pilocarpine is generally regarded as undesirable; its sudorific action is accompanied by lachrymation, bronchorrhœa, and respiratory embarrassment, which oppose serious objections to its application.

Cupping of the loins may be regarded as an attempt at direct local treatment to relieve congestion of the inflamed organs by counter-irritation.

Thirdly, the treatment of œdema. In most cases the treatment above described, which succeeds in promoting the excretion of water through other channels, will be sufficient to obviate any more direct measures. In addition, an excess of fluid is to be avoided as contributing to the causation of œdema, in which connection the reduction of salt must again be mentioned. In some cases, aspiration of a pleural cavity may be necessary to reduce a degree of hydrothorax which is embarrassing the heart by its mechanical influence, or paracentesis abdominis may be performed. In the case of the limbs Southey's tubes will be requisitioned.

Fourthly, the treatment of uræmia. This is a toxic state which is probably due to the formation and retention of some product of disordered metabolism. (The retention in the blood of the normal urinary constituents is apparently incapable of producing acute uræmia, for this condition does not necessarily result from suppression of urine.) An attempt to eliminate the toxins should be made by venesection, accompanied by intravenous saline infusions. Convulsions must be checked by the administration of hypnotics, particularly bromides and chloral. Lumbar puncture is frequently recommended, although we cannot claim to have seen any benefit definitely and with certainty result from its employment.

Finally, after-treatment will be of a tonic character, particularly with the exhibition of iron in doses as large as the digestive system will tolerate. Arsenic, whilst an excellent hæmatinic, is irritating to the kidney. The diet must be regulated with due regard to the state of the urine. But in this connection it is necessary to formulate some ruling as to the condition of continued albuminuria, which is the legacy of

nephritis, and which persists in the absence of all other signs or symptoms. It is the fashion to regard these subjects as suffering from a severe renal lesion which demands complete rest and a rigid diet. Granting the absence of symptoms, there is nothing to be gained by such procedures. In many cases a careful estimation of the amount of albumin shows that the loss is really comparatively small, even 1 % albumin in 50 ounces of urine amounts to $\frac{1}{2}$ ounce only, an amount contributed by an extra pint of milk or the whites of two eggs; in other cases, again, systematic estimation at intervals shows that the albuminuria tends to become gradually reduced in the absence of dietetic treatment. But in any case rigid treatment of such cases is gratuitous; the most scrupulous care will not alter the underlying condition. On the other hand, neglect to diet strictly is not likely to precipitate uræmia. Such patients should be encouraged or persuaded to live a normal healthy life, obviously avoiding exposure to cold and excesses of any kind, and to continue taking iron preferably in the form of the liquor ferri pernitratæ.

Chronic Nephritis.

In the majority of cases the patient will not be identified by his complaint of urinary symptoms, nor may the condition of the urine be a signpost towards diagnosis. In fact, many cases are in existence for a comparatively long time without symptoms of any kind, or with symptoms so trivial that no complaint is made until the development of acute uræmia and rapidly ensuing death.

The first indication may be an apoplectic attack due to cerebral hæmorrhage. Hæmorrhages may occur elsewhere, most commonly epistaxis or hæmaturia. A routine examination of the fundi occasionally leads to the discovery of retinitis, demanding a rigid

investigation for the possible existence of chronic nephritis. An experience of one of us is a case in point. A patient was referred from an oculist to explain the retinitis which had been discovered during a routine ophthalmoscopic examination—the patient's refraction was being undertaken for military purposes. No general condition to explain the lesion was discovered, but twelve months later the patient again came under observation, on this occasion with acute nephritis, evidently superimposed upon a long-standing chronic condition.

In pregnant women, the vascular changes associated with chronic nephritis may affect the placental vessels, and miscarriages not infrequently occur in consequence.

The typical associations of a chronic nephritis which should be looked for in any suspected case are a large left ventricle and a heaving apical impulse, with perhaps a systolic murmur; a ringing (accentuated) aortic second sound. Anæmia of chlorotic type may be present, and almost invariably the blood-pressure, both systolic and diastolic, are raised, the former to 180 mm. or higher. There may be a history of hæmorrhages, e.g. epistaxis, and their presence should be looked for particularly in the retina.

Symptoms of which complaint may be made are headache, insomnia, and a feeling of weakness; breathlessness is common and giddiness frequent. Polyuria may be the presenting symptom.

The relation of the circulation to the renal condition is such that it is frequently impossible to decide which is primarily responsible. In general, one regards the sufferer with "chronic nephritis" as one with "cardio-renal disease," and the two systems as inter-related, although associated signs of high blood-pressure, of albuminuric retinitis and of the characteristic urinary condition (see below), on the one hand, or of precordial pain, irregularity of the heart and shortness of breath,

on the other, denote that the renal or myocardial factor respectively predominates.

The urine in the condition granular kidney (chronic interstitial nephritis) is of low specific gravity (1005-1012). The quantity passed is increased and the percentage of urea is lowered, although the total output of urea is not as a rule diminished. Usually the amount of albumin present is very low, and microscopical examination reveals the presence of very few casts—the condition being one of degeneration rather than inflammation. In a later stage, especially with cardiac failure, the amount of albumin increases.

TREATMENT.—The condition of chronic nephritis is not one of a slowly progressing inflammatory process which is still active, but an effect produced by an original activity which has subsided and by the replacement of the normal kidney substance by fibrous tissue. Any attempt therefore at direct treatment of the kidney is useless, and care is directed towards conserving the kidney, the relief of symptoms as they arise, and the institution of safeguards against complications.

The first consideration will be met by—

(1) The removal of any possible causal factor. The influence of such irritants as lead, alcohol, syphilis and gout in the production of granular kidney is problematical, and in any case when the lesion has developed the mischief is irreparable. Still, such causal factors should be looked for and the possibility of any further influence eliminated, most of all perhaps as regards syphilis.

(2) Reduction of strain upon the renal function. The diet should contain a minimum of extractives, so that meat should be taken in small quantity only, and such substances as contain purins in excess avoided. Alcohol, too, must be taken sparingly. Sweetbread, liver, beef, pork, mutton, chicken, veal, salmon are relatively rich; whilst oatmeal, vegetables,

milk, eggs, cheese, butter, sugar, are free from or relatively poor in purin bodies. Tea, coffee, cocoa and malt liquors again contain purins which are deficient in wines and spirits, although the latter are inadmissible from the large proportion of alcohol they contain.

It is evident that the traditional selection of white meat as opposed to red is unjustified if the avoidance of purins is the important consideration, since as regards the purin content there is little to choose between them. In general, too, it may be said that in the regulation of the diet for a chronic nephritic it is the avoidance of excess of any kind of food which should be the chief indication, since oxidation of proteins (which appears to be the aim of most régimes), whilst achieved by lessening the total intake of proteins, will be defeated by an increase of protein spacers, e.g. carbohydrates. It is more important to restrict the quantity of food taken than to eliminate certain constituents.

As an average daily diet, that suggested by Dr. Langdon Brown may be quoted. It consists of bread 16 ounces, butter 2 ounces, mutton or fish 3 ounces, potato 6 ounces, green vegetables 4 ounces, one egg and one pint of milk. Such a dietary yields 2,690 calories.

Secondly, the work of the kidney may be reduced by increasing elimination through the other channels, the bowels and the skin.

For the regulation of the bowels saline aperients or hydragogue cathartics, such as pulvis jalapæ compositus, should be taken every morning or at fairly frequent intervals. The skin is kept gently active by regular exercise, which demands only a moderate degree of exertion, and in this way, too, elimination through the lungs is encouraged. If the patient's condition permits, a weekly Turkish bath may with advantage be taken. Flannel, or a mixture of wool and silk, should be worn next the skin.

Thirdly, general hygiene. The sufferer from chronic

nephritis should be regarded as a perpetual convalescent, and appropriate treatment includes, in addition to dietetic regulations, care of the skin and selection of suitable clothing, as already referred to, the avoidance of chill and of undue fatigue. Naturally such patients are always at their best in an equable climate, whenever such residence is possible. The regular administration of iron is to be recommended whenever the condition of the digestion permits.

(3) SYMPTOMATIC TREATMENT.—(a) The blood-pressure. It is doubtful how far it is possible permanently to reduce a raised blood-pressure and how far such reduction if possible is advisable. But whilst in many cases no inconvenience appears to arise therefrom, in certain cases distressing symptoms do appear to be definitely related to a high blood-pressure, and nitro-glycerine in full doses, or a mixture of sodium nitrite, 2 grains, and sodium nitrate, 10 grains, may be administered. The traditional employment of potassium iodide acquires additional interest in view of the influence of syphilis in the production of arterio-sclerosis and the relation between this condition and granular kidney. The great reputation which this drug has quite deservedly obtained may really be due to its anti-syphylitic action.

(b) Headache, whether the result of high blood-pressure or of a mild degree of chronic toxæmia. Sir John Rose Bradford recommends pilocarpine in small doses for this condition, and if the headache is particularly troublesome at night and prevents sleep, the best hypnotic is *cannabis indica*—20 to 30 minims of the tincture.

In later stages *œdema* may develop and demand a more rigid regulation of the diet, and particularly the reduction so far as possible of sodium chloride ("salt-free diet"). The skin will require more rigorous stimulation, as by vapour or hot-air baths or the hot wet pack. Pilocarpine in sufficiently large doses to

produce a considerable degree of perspiration is not to be recommended, on account of the distressing effect upon the lungs, etc., it is liable to cause. As diuretics, caffeine, theobromine and diuretin are sometimes of value, and the well known diuretic pill (Pulv. digitalis gr. i. Pulv. Scillæ. gr. i., Pil. hydrarg. gr. i., Extr. hyoscyam gr. i.) may be given once or twice a day. Notwithstanding such methods, it may be necessary to relieve the œdema directly as by aspiration of the chest or abdomen, or by employing Southey's tubes in the case of the legs.

Later still uræmic symptoms may progress with vomiting and diarrhoea. The latter is best left unchecked. (See also page 75.)

In the treatment of chronic nephritis the specific use of renal extracts has sometimes been recommended. The chief objection to their employment, empirical at any rate, is that there is no evidence of the kidney possessing an internal secretion. At the present day this therapeutic measure appears to possess no prominent supporters.

Decapsulation for chronic nephritis, which has been for many years under consideration, has of recent date been brought into prominence by several investigators, who quote examples of cases greatly benefited, and in certain instances even cured, by the operation. It is difficult to select the class of case likely to be successful. It is generally agreed that a young subject with œdema, polyuria, or oliguria, and one who is passing considerable quantities of albumin, is the most favourable, and that cardio-vascular changes are a contra-indication, although cases with high blood-pressure who have benefited have also been reported.

The operation appears to afford an additional passage for lymph to flow out of the kidney, so ensuring better drainage of the toxic elements, which are otherwise not eliminated.

CHAPTER X

SUPPURATIVE LESIONS OF THE KIDNEY

THE formation of pus in the kidney may be the result of primary disease in that organ, or it may be secondary to diseases of the lower urinary tract. The diagnosis is determined by symptoms referred to the bladder, by cystoscopy and by changes in the urine. Skiagraphy assists by demonstrating the size of the kidneys and the presence or absence of abnormal shadows, e.g. those of stone and patches of caseation.

Reference must be made to certain hæmatogenous infections of the kidney which closely resemble in their symptoms the so-called medical kidney, but in which the cause can be definitely traced to certain organisms, the most common of which is streptococcus. In these cases the amount of pus excreted may be small, simulating in this respect the urine seen in pyelitis of *Bacillus coli* origin. The disease affects one or both kidneys.

Treatment of primary pus-formation, e.g. streptococcal nephritis, calculous pyonephrosis and tuberculous pyonephrosis should be referred to the surgeon at the earliest possible moment, and catheterisation of the ureters is necessary in order to draw off urine from each kidney for the dual purpose of estimating the renal function and determining whether one or both organs are diseased. Removal of one kidney is contra-indicated unless it is established beyond doubt that the other is quite healthy and functioning normally. Palliative treatment, such as local applications to the loin and the internal administration

of drugs, should only be resorted to when there is unavoidable delay in operative interference or the disease is bilateral. A turpentine stupe applied to the loin will relieve the aching pain common to these cases. A popular remedy is a very pliable rubber hot-water bottle which will fit closely round the loin; this is equally efficacious as an analgesic, and possesses an added advantage since it can be indefinitely renewed. Aspirin and morphia may be given if the pain is severe.

One of the more common primary infective diseases is pyelitis, which is due to infection by a coliform bacillus. Treatment usually rests with the practitioner. The patient should drink large quantities of non-alcoholic fluids—e.g. Vichy, Contrexèville or barley water. In order to render the urine alkaline and thus prevent further growth of the organisms, sodium or potassium bicarbonate in doses of not less than 30 grains must be given four-hourly. Additional treatment is lavage of the renal pelvis with a weak solution of silver nitrate.

Stock and autogenous coliform vaccines are considered by some to do much good. Small doses should be given once a week in the early stages of the disease, e.g. two million bacilli, and in the later stages as large a dose as 200 millions. In the opinion of the authors they do no harm, and as little good. Rest and warmth are essential, and the patient should remain in bed for at least forty-eight hours after the complete disappearance of both pain and fever. In pyelitis, operative measures are fortunately seldom required, but attacks of pain or fever or both are liable to recur, even at long intervals. No alarm need be felt at the continuation of night sweats for many weeks after the disappearance of the more acute symptoms, but the patient must be careful to avoid chill until they have gradually ceased. The symptoms of the adult form of this disease,

which is chiefly observed amongst pregnant women, are remarkable for their similarity to appendicitis; and although they may return with each succeeding pregnancy, permanent damage to the kidney is unlikely. Prophylactic doses of potassium bicarbonate should be given at the commencement of pregnancy.

When the suppurating condition of the kidney is caused by an ascending infection from the lower urinary tract, as, for example, cystitis, due to either enlargement of the prostate or stricture, great credit will reflect upon the practitioner if he prove successful in relieving the more acute symptoms. It must, however, be borne in mind that an ascending infection of the kidney can never be ameliorated or cured unless the cause of the obstruction in the lower urinary tract is removed, but temporary relief can be obtained by carrying out the following treatment. Both for enlarged prostate and stricture, as large a catheter as will pass the obstruction should be tied in, and the bladder irrigated twice daily with a weak antiseptic solution (silver nitrate 1 in 5,000, potassium permanganate 1 in 5,000, or oxycyanide of mercury 1 in 5,000). Should the urethra be intolerant to the retaining of a catheter for some days, the urologist must be consulted with a view to draining the bladder above the pubes (suprapubic cystotomy and insertion of the De Pezzer tube, see page 106).

The golden rule, that whenever there is pus-formation in the body it should be immediately evacuated, holds good in the case of suppurative lesions of the kidney. By tying a catheter into the bladder the whole urinary tract is drained freely. Besides free drainage we must be sure of free irrigation, in order that the lower urinary tract may be cleared of septic material.

Irrigation of the upper urinary tract, that is the

kidneys and ureters, may be carried out by increasing the flow of fluids through the kidneys. There are four ways by means of which this can be effected ; by the mouth, by the rectum, by subcutaneous and intravenous injections.

If the condition is not very serious, the administration of large quantities of fluids by the mouth will suffice. One of the best and most pleasant for the patient is Contrexèville water, of which at least 4 pints should be drunk in twenty-four hours. Another excellent beverage for these cases is parsley tea. This may readily be made by pouring boiling water on chopped-up parsley. The solution should be concentrated, and the quantity given the same as in the case of Contrexèville water.

Where uræmia is threatened or actually exists, fluids by the mouth are insufficient. Physiological saline at body temperature must be given, either by the rectum or intravenously, slowly and cautiously until 6 pints have passed into the circulation. After an interval of four hours another 3 pints may be given by the same method. Thus patients who at first sight appear to be moribund often recover in a remarkable manner. The only drug of value to be given by the mouth is hexamine (5 grains, four-hourly). Hot-air baths are strongly recommended by some authorities to reduce toxæmia by profuse sweating ; but the artificial production of sweating puts undue strain upon the heart, and may prove extremely dangerous. In conclusion, the treatment by the general practitioner of suppurative lesions of the kidney caused by an ascending infection may be summarised in four words : " Free drainage, free irrigation."

CHAPTER XI

BACTERIURIA

THIS term must be restricted to the presence of organisms in urine freshly voided, since a perfectly healthy sterile urine may eventually exhibit the presence of micro-organisms if allowed to stand uncovered for a variable period, depending upon the external temperature and other circumstances.

It is obviously necessary before a diagnosis of pathological bacteriuria is made that a specimen is collected by catheter with all aseptic precautions, since the urethra normally contains a variety of organisms of non-pathogenic character.

Assuming, however, that a definitely infected urine is under consideration, the cause may be a generalised infection or a local lesion, by which is meant infection from some part of the urinary tract. For example, the kidney may contribute organisms of which the commonest are *Bacillus coli*, the tubercle bacillus, *Staphylococcus aureus*, pneumococcus. The same organisms may be derived from the bladder, the prostate and the urethra, with the addition, in the case of the two latter, of the gonococcus. These conditions are considered elsewhere.

But the chief interest in bacteriuria lies in the possibility of a general infection without disease of the urinary organs. In such cases the contamination necessarily arises from some source of sepsis external to the urinary tract. Sometimes such a source is ascertainable, e.g. a carious tooth or a septic tonsil, but frequently no such focus of infection can with

certainly be detected, and it would appear, particularly in infection by the *Bacillus coli*, that the normal denizens of the intestine acquire pathogenic properties and induce a generalised infection in which the organisms can be isolated from the urine, if not from the bloodstream. An infected appendix may be at the bottom of the mischief.

In such cases we are often confronted with an illness displaying profound constitutional disturbance, pyrexia, perhaps vomiting and rigors, but without physical signs of any description. The nature of the illness is only elucidated by a routine examination demonstrating a pathological urine. The latter may be normal in appearance, but generally it exhibits a turbidity which is not dispersed by filtration. In some cases blood may be present, and impart its characteristic appearance. The reaction is usually acid. Frequency of micturition is generally, although not invariably, present.

TREATMENT.—Any source of infection must, if ascertained or suspected, be removed. The colon is disinfected by the administration of calomel and the injection of large enemata. The patient is confined to bed during the stage of acute illness and placed upon the bland diet commonly employed in cases of fever. The drug *par excellence* to be employed is urotropin, in doses of 10 grains given three times a day with a tumbler of water. Urotropin is efficient only in an acid urine, so that before this drug is administered care must be taken to ensure a suitable reaction in the urine. It is often far from easy to render an alkaline urine acid, and the only drugs which are utilised to this end are benzoic acid and the acid sodium phosphate, more usually the latter. Considerable controversy has arisen as to the principle of administering this salt together with urotropin, and until com-

paratively recently such a practice was held to be bad in the expectation that the effect of the acid would be to liberate formaldehyde from the urotropin in the mixture, and not, as is desired, at the time of contact with the acid urine. But it does not appear that as a matter of fact formaldehyde is thus produced by the hydrogen-ion in acid sodium phosphate, and it is nowadays a common practice to administer the two simultaneously if it is desired to render the urine acid.

An alternative measure to disinfection of the urine is to render it alkaline by the administration of large quantities of sodium bicarbonate with citrate of potash, and so provide a milieu in which the *Bacillus coli* cannot flourish.

Bacteriuria may be a very chronic, long persisting condition, and it is neither desirable nor necessary in the absence of definite indications to persist in a rigid treatment as regards restriction of diet and advice to refrain from occupation and other activities. A very efficient form of treatment in all urinary infections is vaccine-therapy. Although a stock vaccine may be employed, particularly in the case of coli-infection, far better results will be obtained by the use of an autogenous vaccine prepared by the cultivation from a catheter specimen of the patient's own urine.

CHAPTER XII

TUBERCULOSIS OF THE URINARY TRACT

TUBERCULOUS affections of the genito-urinary organs most commonly appear between the ages of eighteen and forty years. The primary lesion is situated in one or both kidneys or in the genital organs. The bladder is always secondarily affected by direct spread of the infection from above or below. With affections of the genital organs we are not immediately concerned, but in all cases where the tubercle bacillus has been found in the urine it is important to examine the testicles, prostate, and seminal vesicles as a possible source of infection.

So insidious is the onset of renal tuberculosis that symptoms of the disease rarely manifest themselves before the bladder becomes infected. Hæmaturia without any other vesical symptoms is so rare as only to merit a passing comment. The common symptom of a tuberculous lesion is frequency of micturition due to cystitis. The complaint may be made of painful micturition when, owing to the development of urethritis, the passage of urine causes a sensation of soreness.

In a young man, pale and thin, who complains of disturbance of his night's rest due to a frequent desire to micturate, suspicion should be at once aroused that tuberculosis is the cause of his ill health. A bacteriological examination must be made of the urine, and if on the first occasion the tubercle bacillus is not found, another examination should be made at a later date, for the organism is not readily discovered in this medium. Pus and sometimes blood are also constituents of a tuberculous urine. Even if tubercle

bacilli are not found in the urine the diagnosis should not be rejected until cystoscopy has been performed.

The patient should be cystoscoped and both ureters catheterised in order to ascertain whether, if present, the disease is unilateral or bilateral. It is possible to detect the presence of tubercles in the bladder mucous membrane; still more valuable evidence may be obtained by comparing the appearance of both ureteric orifices. Subsequently the urine from each ureter is bacteriologically examined, and thus a definite diagnosis can be made.

If one kidney only is diseased, surgical interference is indicated, and the patient should be subjected to nephrectomy. Evidence of the presence of the tubercle bacillus in the genitalia as well as in one kidney does not contra-indicate this operation, for experience shows that it results occasionally in complete cure, and invariably in improvement of the disease in these organs when they are secondarily infected.

After removal of the primary focus it is necessary to treat the tuberculous cystitis. This consists of (1) dietetic restrictions, (2) the administration of urinary antiseptics by the mouth, and (3) tuberculin injections.

(1) *Dietetic Restrictions*.—This subject is discussed at the end of the chapter under the treatment for bilateral tuberculous disease of the kidneys.

(2) *Urinary Antiseptics*.—There are only a few drugs to be taken by the mouth which act as urinary antiseptics. The more important are urotropin, boric acid, and sandal wood oil. The first named has the greatest antiseptic power; boric acid has the least. In a certain percentage of cases, urotropin increases the frequency of micturition by irritating the mucous membrane of the bladder. Sandal wood oil in capsules of 5 minims is an excellent substitute in

such cases, and should be given every four hours, and continued for a period of three months.

(3) *Tuberculin Injections*.—See page 90.

Secondary infection of the tuberculous bladder with other organisms is a serious complication the risk of which can be obviated by avoiding intra-vesical manipulation such as lavage. For the same reason the passage of urethral instruments should be rigidly restricted to those occasions when they must be employed for diagnostic purposes.

Inoperable Urinary Tuberculosis.

Whilst there are definite surgical indications, such as pyonephrosis, acute paroxysmal pain and continued pyrexia, as well as the prospect of eradicating a limited focus of infection as in one kidney, the practitioner is sometimes confronted with the treatment of a case in which both kidneys are involved, or in which the renal affection is accompanied by evidence of tuberculous disease elsewhere in the body. It may be stated that the presence of cystitis is no contra-indication to nephrectomy, since improvement of the bladder will ensue upon the removal of the primary focus.

But where operation is clearly out of the question, the treatment must be a compromise between the attempt to deal with a tuberculous subject upon general lines and the limitations imposed by the existence of a renal lesion. Whilst restrictions are inevitable, the position adopted aims at regarding the patient as a tuberculous rather than as a renal subject.

Medical treatment must be considered under the headings of climate, food, general hygiene and drugs.

A great deal of controversy has arisen respecting the most desirable climate for such a patient. There is pretty general agreement that a maximum of sunlight is preferable, but whereas much may be said in favour

of a cold dry atmosphere for phthisical patients generally, the renal subject will be best suited by a relatively temperate climate at sea level, the Mediterranean littoral offering perhaps the best advantages, provided of course the patient can tolerate the necessary travelling. Otherwise the west and south-west coast in this country are to be recommended.

As regards food, indigestible materials and such constituents as are liable to over-burden the renal function, e.g. the heavier kinds of meat and fish, are to be avoided, as well as those vegetables, such as asparagus, which contain salts known to irritate the kidney. Alcohol, too, must be forbidden. On the whole the diet should consist largely of milk and vegetables. Cod liver oil, which is both a drug and a foodstuff, is given, as in most cases of tuberculous disease.

Hygienic considerations for the most part comprise a maximum of fresh air, with a due proportion of rest, with exercise strictly graduated to the patient's capabilities. Sanatorium discipline is desirable, but without arbitrary regulations which are not adapted to individual requirements. In other words, residence in a sanatorium itself is not to be recommended. Flannel should always be worn next the skin. In addition to cod liver oil, which has already been mentioned, and perhaps arsenic, only such drugs will be given as are necessary to combat or relieve symptoms as they arise.

Tuberculin injections require mention, since they are frequently recommended as of special value in the treatment of tuberculosis of the genito-urinary organs. They are administered subcutaneously once a week, the dosage commencing at $\frac{1}{10,000}$ milligram, increasing gradually to $\frac{1}{10}$ milligram. Such treatment must be continued for at least two years.

CHAPTER XIII

CYSTITIS

THE origin of bladder inflammation may be found in a blood infection or secondary to some lesion of the urinary tract, e.g. the kidney or urethra, or an affection of the bladder itself, such as a stone, tuberculosis, or a growth.

Cystitis due to Blood Infection.

Cystitis of hæmatogenous origin is a condition which occurs in both sexes, but more frequently in women. The organism commonly responsible is the *Bacillus coli*, but the streptococcus, the staphylococcus and the pneumococcus have also been recorded as infecting the bladder via the blood-stream.

The disease is ushered in with a sudden attack of hæmaturia, followed by a rise of temperature and frequency of micturition. The quantity of blood passed varies with the severity of the inflammation. Occasionally the first indication of acute cystitis is limited to a rise of temperature, which may possibly cause a mistaken diagnosis of influenza, but after twenty-four hours the bladder symptoms assert themselves, and the correct interpretation of the condition becomes obvious. Besides the vesical symptoms to which reference has already been made, there is a sensation of smarting along the urethra during the passage of urine, and a feeling at the end of the act of micturition that evacuation of the bladder has been incomplete. Strangury is also present. Examination of the urine will reveal the presence of blood, pus, albumen and

micro-organisms; the diagnosis of primary inflammation of the bladder will be confirmed by cystoscopy.

TREATMENT.—The patient should be confined to bed until the temperature has remained normal for at least forty-eight hours.

A rubber hot-water bottle applied to the suprapubic region will relieve the strangury, but if the latter is very severe $\frac{1}{4}$ grain of morphia should be given hypodermically. Drug treatment will vary according to the nature of the organism. If infection is by the *Bacillus coli*, potassium bicarbonate, 30 grains every four hours, must be given by the mouth. If by one of the cocci group, urotropin 10 grains and tincture of hyoseyamus 1 drachm four-hourly. Vaccines are useless during the acute stage, and bladder lavage is obviously contra-indicated. Under this treatment the inflammation disappears in the majority of cases, but occasionally the disease passes into the chronic stage, and it is then that vaccines and bladder lavage are useful. An autogenous vaccine commencing with very small doses, which are gradually increased, should be given once a week. A catheter should be passed weekly, and the bladder irrigated with 1 in 10,000 silver nitrate, which, after the lavage has been carried out two or three times, may be increased in strength to 1 in 5,000. Search for a primary focus in cases of hæmatogenous infection of the bladder must never be neglected. A focus can rarely be found, but that is no excuse for neglecting to make the attempt. Boils, carbuncles, tonsillitis, pyorrhœa and chronic constipation are recognised as possible causes of infection, all of which should receive appropriate treatment; but there will always be a large number of cases in which the source of infection is never determined.

Cystitis Secondary to a Lesion of the Kidneys.

Bacterial infection of the kidneys commonly spreads down the ureters to the bladder and sets up a localised cystitis.

Examples of this spread of infection are observed in the pyelitis of pregnancy, acute pyelonephritis and renal tuberculosis.

A certain case is recalled when recurrent attacks of fever were associated with slight frequency of micturition. The urine was examined and found to contain the *Bacillus coli* and a few blood and pus cells. Cystoscopy revealed an area of acute inflammation around the left ureteric orifice, but no change on the right side. The left kidney was tender on deep palpation. The signs and symptoms pointed, therefore, to a unilateral pyelonephritis, with a secondary localised cystitis. Treatment by rest in bed while the fever persisted, and the administration of large doses of potassium bicarbonate (30 grains four-hourly) by the mouth, resulted in rapid disappearance of the symptoms.

When symptoms point to an attack of cystitis being secondary to a renal lesion, not only should the urine be examined for bacteria, but radiography of the whole urinary tract is recommended, to exclude the presence of stone.

It must not be forgotten that a stone may form and remain in the kidney "silent" and unsuspected for a number of years, but all the while damaging and undermining the vitality of the renal cells. Owing to the lowered resistance these tissues become infected and cause an attack of fever and a localised cystitis. In a few days the symptoms pass off, and again the stone is "silent."

Cystitis due to Direct Spread from the Urethra.

Urethritis of gonococcal origin, if treated during the acute stage of the disease by such severe local manipulation as the passage of bougies, catheters, etc., may spread to the bladder and give rise to an acute cystitis. So acute may this inflammation become that actual gangrene of the mucous membrane may occur.

A fatal case is on record in which an attempt had been made to abort an attack of acute urethritis by means of instrumentation. Gangrenous cystitis was caused, resulting in the whole bladder wall sloughing, and death taking place from gonococcal septicæmia. Such cases are rare; but cystitis due to the gonococcus in the initial stages is always severe, and causes profuse hæmaturia.

This condition is prone to become chronic and prove very intractable, pyuria persisting for many years.

Local treatment consists of lavage with 1 in 10,000 silver nitrate, potassium permanganate 1 in 5,000, and hydrogen peroxide.

Infection of the bladder through neglect of aseptic precautions in instrumentation is unfortunately a familiar occurrence, and occasionally even the most scrupulous preventive measures cannot eliminate infection when the bladder has undergone degenerative changes, the result of stricture of the urethra or disease of the prostate.

Cystitis Secondary to Vesical Growth.—Pus-forming organisms find in malignant disease an excellent soil on which to multiply, and in no part of the body is this more pronounced than in the bladder. In fact, the first indications of the presence of a vesical growth are usually the symptoms of cystitis. It is this complication which terminates the patient's life by spreading the infection to the kidneys.

Cystitis due to tuberculosis is separately considered in the chapter on "Tuberculosis of the Urinary Tract."

CHAPTER XIV

BLADDER TUMOURS

THE examination of a patient in whom the symptoms point to disease in the urinary tract can never be complete without the aid of the cystoscope, and in no lesion is this more apparent than in growth of the bladder. The cystoscope will reveal whether the tumour is a papilloma or a malignant neoplasm, and in respect of the latter whether advanced or in the early stages of growth.

A painless intermittent hæmaturia is the usual symptom of simple villous or papillomatous disease, but with respect to vesical cancer, apart from hæmaturia, there may be cystitis and pain in the suprapubic region.

The treatment of simple tumours has in recent years undergone a marked change, for whereas it was customary to remove these growths by open operation, it is now possible to destroy them by the action of the diathermic current. The electrode is passed into the bladder with the aid of the cystoscope, several applications of the current being necessary before the patient is cured.

The treatment of malignant growths may be considered from the *pre-operative* and *post-operative* aspects, and in the application of suitable methods to *inoperable cases*.

(1) PRE-OPERATIVE TREATMENT.—Much may be done by the patient's medical attendant to reduce his discomfort to a minimum before he comes under the care of the surgeon. Attacks of pain and hæmorrhage

require immediate treatment during the pre-operative period. Pain, which is of the nature of a strangury, is relieved by repeated doses of tincture of hyoscyamus given by the mouth. Less than drachm doses three times a day will be found ineffectual.

It occasionally happens that portions of growth are cast off free into the bladder, or that large blood-clots form, causing such acute pain as to necessitate a hypodermic injection of morphia. When this occurs operation should not be delayed.

Hæmorrhage from a growth of the bladder will often tax the practitioner's ability and patience. The bleeding may be persistent or intermittent. In the former case, usually the less severe, a catheter should be passed and the bladder irrigated with a solution of silver nitrate 1 in 5,000, at a temperature of 120 Fahr. This should be carried out daily.

In passing a catheter the strictest aseptic precautions must be adopted, for the introduction of sepsis into the bladder, the seat of the growth, is a serious complication. Numerous drugs have been recommended for the arrest of persistent hæmorrhage. Of these the better known are ergot, calcium lactate and iron salts. The authors have seen no good whatever result from their administration.

The patient should be warned against the severe bleeding that will ensue from all violent exercise, such as horse-riding, running, etc.; also of the danger of increased blood-pressure caused by high living and indulgence in alcohol.

The treatment recommended for persistent bleeding must in no way be considered to replace or cause any delay in operative interference. When blood is found in the urine, expert advice should be obtained at the earliest opportunity. In cases of intermittent hæmorrhage, the bleeding is often so profuse as to

result in extensive clot-formation with retention of urine. An attempt may be made to relieve the more acute symptoms by evacuating the clot with Bigelow's evacuator, but blockage usually results, and at best it is a purely temporary measure. In such cases immediate surgical interference is required.

(2) POST-OPERATIVE TREATMENT.—Following removal of a bladder tumour and healing of the suprapubic wound, the patient should be instructed to report every six months for *examination of the urine*. Recurrence of growth is insidious in its onset, and if he is wise the practitioner will send his patient at least once a year to an urologist for cystoscopic examination. Thus only is it possible to detect an early return of the disease.

(3) TREATMENT OF INOPERABLE CASES.—It is here that the practitioner's efforts to relieve pain and distress are severely tested. All such cases should be submitted to an expert examination with a view to treatment by *fulguration*, *radium*, or a *permanent suprapubic cystotomy*. If hæmorrhage is severe, or there is such frequency of micturition as to prevent the patient from getting a good night's rest, an urologist should be called in with a view to performing a permanent suprapubic cystotomy. Irrigation of the bladder via the urethra may become impossible owing to blockage of the internal meatus by growth, or cause such pain as to render the patient exhausted. The experience of the authors is that all inoperable cases eventually require a suprapubic cystotomy. Following this operation the patient will again pass into the hands of his usual medical attendant, who will be expected to advise how the skin around the suprapubic fistula may be prevented from becoming excoriated, and what dressings will be necessary. The application of an ointment consisting of zinc

and castor oil in equal parts thickly spread over the whole of the skin of the suprapubic region will keep it in a healthy condition. The urine from this fistula can best be drained by a rubber tube passed through an indiarubber flange into the bladder, the other end being attached to a portable urinal. Between the flange and the skin should be placed a layer of gauze smeared with castor oil and zinc ointment. The gauze must be changed daily.

For pain, various drugs may be used. That which the authors favour most is aspirin, which should be given in doses of not less than 15 grains three times daily. Morphia and its preparations should only be resorted to when the patient has become resistant to all other analgesics or in the very last stages of the illness. In order that the analgesic effect of aspirin may be prolonged it should be given alternately with phenacetin. It should not be forgotten that the effects of repeated doses of morphia are to cause marked constitutional disturbances of such a character as to produce a condition of mental degeneration in the patient which results in great distress to those around him.

CHAPTER XV

DISEASES OF THE PROSTATE

Inflammation.

THE most common cause of inflammation is an attack of gonorrhœa, but cases are recorded where there is no history of such infection, and the organisms isolated in these cases are the *Bacillus coli* and staphylococcus: the tubercle bacillus may also be responsible, associated with a secondary infection, in which case the primary focus is in the testicles or kidneys.

Gonococcal Infection of the Prostate.

In 80 % of cases of gonorrhœa the prostate becomes involved, resulting in definite constitutional disturbances, which necessitate special treatment. A rise of temperature, pain in the back, and increased frequency of micturition in an attack of gonococcal urethritis, indicate that the inflammation has spread to the posterior urethra and prostate. Rectal examination, by demonstrating tenderness of the prostate on palpation, confirms the diagnosis.

The patient should be made to realise that his condition is serious, and must immediately take to his bed.

TREATMENT consists of hot baths twice daily, the administration of hexamine, 5 grains, three times daily by the mouth, and free purgation. Urethral irrigation is contra-indicated. In a mild case, ten to fourteen days will see a complete cessation of the acute symptoms, after which the patient must be submitted to prostatic massage and irrigation of the posterior urethra with weak antiseptic lotions. Some-

times pus will develop in the prostate, producing a large abscess, which causes pain both on micturition and defaecation. Under the treatment recommended for acute prostatitis, the abscess will in the majority of cases empty itself by bursting into the urethra. In such an event the patient obtains immediate relief and rapidly recovers from the acute symptoms. In a few cases the symptoms are extremely severe, and the patient becomes so ill that surgical interference is a necessity. An incision is made in the perineum between the bulbo-cavernosus and the anus, and the swollen prostate felt behind the urethra. The abscess is opened and drained, care being taken to avoid injuring the urethra when plunging the knife into the prostate. On no account should the abscess be opened by the rectal route, to avoid the danger of infecting the peri-prostatic tissues with the *Bacillus coli*.

For the treatment of chronic prostatitis of gonococcal origin the reader is referred to the literature on venereal disease.

Non-Specific Infection of the Prostate.

The prostate when infected with organisms, other than the gonococcus, becomes what may be termed "irritable," that is to say, the inflammation is of a low degree, causing irritative phenomena in connection with micturition and sexual desire. There is frequency of micturition both by day and night and an abnormal sexual appetite. The diagnosis is made by bacterial examination of the prostatic secretion, posterior urethroscopy, and rectal examination.

The patient, while strenuously denying exposure to specific infection, will admit a slight muco-purulent discharge from the urethra, and unless careful examination be made, the tendency will be to doubt the veracity of his statement,

By massaging the prostate, and then instructing the patient to pass the first ounce of urine into a sterile bottle, a specimen of the prostatic secretion is obtained, which, when subjected to bacteriological examination, will demonstrate the presence of the tubercle bacillus, *Bacillus coli*, or other non-venereal organism.

Posterior urethroscopy shows inflammatory changes around the verumontanum and prostatic ducts; and finally palpation through the rectum reveals nodules in the gland and thickening of the seminal vesicles.

The treatment will depend on the type of organism isolated by the bacteriologist. If the tubercle bacillus is found, thorough examination of the genitalia and kidneys must be conducted in order to demonstrate the site of the primary focus. Treatment then consists in removal of the primary focus, followed by a course of tuberculin injections, fresh air and tonics and general hygienic precautions. The prostatic lesion is made worse by urethral instrumentation or irrigation.

TREATMENT, if the disease be caused by the *Bacillus coli*, staphylococcus, etc., must be on the following lines: The organism is isolated, and from it an auto-genous vaccine is made, which is injected into the patient subcutaneously, commencing with small doses (e.g. 50 millions), and gradually increasing at intervals of a week to 500 millions. Associated with this treatment, massage of the prostate must be undertaken, followed by irrigation of the posterior urethra with weak antiseptics, such as potassium permanganate 1 in 10,000 and oxycyanide of mercury 1 in 10,000. The prognosis is good.

Simple Enlargement of the Prostate.

With the introduction of total enucleation by Freyer in 1901, the treatment of enlarged prostate underwent a radical change. Until then this condition had

been treated either by drugs "to reduce the congestion," by the constant passage of a catheter, or by an operation, which consisted in picking away portions of the organ with scissors, scoops and forceps. Vasectomy was also employed as an indirect method of reducing the size of the gland. For a time this procedure was popular and commonly practised at St. Peter's Hospital prior to Freyer's epoch-making innovation.

The necessity of removing the prostate before secondary changes occur in the bladder, ureters, and kidneys, cannot be too strongly insisted upon. In all cases the percentage of deaths occurring under expert operative treatment is low, but it would be considerably lower were those cases eliminated when the operation has been undertaken as a measure of urgency.

So insidious is the deviation from the normal associated with an enlarged prostate that the patient generally regards such changes as the natural consequence of advancing years. He finds that he is obliged to break his night's rest by rising to micturate once, perhaps twice; moreover, with the desire comes an urgency for relief. Besides this lessening of control a slight strain is always required to expel the urine. All of these symptoms may not be manifest at once, and in the early stages of the disease the layman seldom observes more than one, but the prudence of the medical practitioner he consults should elicit further evidence.

Although years may pass between the onset of the symptoms and the condition when life becomes a burden, the gradual increase in discomfort necessitates medical advice.

Commencing enlargement of the prostate can be recognised by two methods of examination—palpation of the gland *per rectum* and cystoscopy. As stricture will give rise to symptoms similar to those of com-

mencing enlargement, urethroscopy may be necessary. Thus other possible causes of nocturnal frequency, straining and precipitancy of micturition, are excluded. The quantity of residual urine, that is, the amount of urine remaining in the bladder, after the voluntary attempt to expel the whole contents has been made, is in the early stages of prostatic enlargement between 1 and 3 ounces.

The gland enlarges principally in two directions, superiorly into the bladder and posteriorly towards the rectum. When the main enlargement is towards the bladder there may be little or nothing abnormal palpable *per rectum*, the projection of the prostate being chiefly intravesical. This latter is always a pathological condition, and is confirmed by the appearance of the internal meatus in both ante- and post-mortem examinations. Moreover, it is when the gland enlarges superiorly that the urinary symptoms present themselves most quickly.

With the aid of the cystoscope it is possible to detect the presence of prostatic growth within the bladder, but if the abdominal wall is flaccid, occasionally this projection can be detected by means of bimanual examination, viz. one finger in the rectum and pressure of the other hand above the pubes.

When enlarged towards the rectum the gland is felt as an elastic swelling and is mobile bimanually. Thus when investigating a case of suspected prostatic enlargement the following procedure must be adopted:

The patient passes all the urine he can into a glass receptacle in the presence of his medical adviser, so that the latter may study any alteration in the urinary stream and the appearance of the urine. A rectal examination is then made, and followed by a bimanual one. A Coudé catheter is passed in order to estimate the amount of residual urine.

Should the catheter meet with an obstruction in the anterior urethra, urethroscopy is required to exclude the presence of stricture. Finally, cystoscopy may be necessary to confirm the diagnosis.

TREATMENT.—The correct treatment for this disease is removal of the whole gland by operation. Catheterisation as an alternative measure is a dangerous practice and should be discouraged, for however careful in the sterilisation of the instrument the patient may be, cystitis is certain to occur, owing to the degenerative changes in the bladder wall. If renal failure is present at the time of examination of the patient, preliminary suprapubic drainage of the bladder is necessary to relieve the more urgent symptoms. At a later date, if the kidneys recover their function, the surgeon can proceed with the operation of total enucleation of the gland.

Carcinoma of the Prostate.

One of the most insidious and chronic forms of malignant disease is that which attacks the prostate gland. Two clinical types are recognised, the scirrhus variety and the adeno-carcinomatous; but the latter manifests itself as a simple enlargement in the early stages, and is with difficulty diagnosed as cancerous without the aid of the microscope.

The presence of malignant cells in a certain number of enlarged prostates, which clinically are simple, is strong evidence in favour of removal by operation of the gland as soon as it interferes with the normal function of micturition.

Patients suffering from malignant disease of the prostate universally complain of pain—a symptom absent in simple enlargement—in the region of the perineum, especially on pressure, such as when sitting on a hard seat. As the disease progresses, pain may

be referred to the external genitalia and thighs. The stream of urine on micturition is observed to get smaller, and there is an increasing strain to empty the bladder. Thus in the early stages the subjective symptoms are few, and the general condition of the patient remains good, but with the spread of the disease to the base of the bladder and the glands of the pelvis, cachexia and loss of weight manifest themselves.

Palpation of the gland *per rectum* will establish the diagnosis, although the additional examination of passing a catheter will help to exclude simple enlargement, for the quantity of residual urine in early malignant disease is negligible.

The gland, as felt *per rectum*, is stony hard, and, when the disease is advanced, immobile bimanually, and found to merge into the tissues and organs around. Owing to the narrowing of the prostatic urethra a full-sized catheter cannot be passed.

TREATMENT.—If the disease is discovered early and the gland is movable bimanually, operative interference leads to some measure of success, and should therefore be the treatment of choice. The growth can be removed by the perineal route or suprapubically through the bladder.

If, on the other hand, the gland is fixed, little hope can be entertained from the results of removal by the knife. In radium we have a remedy that is worthy of trial in all cases which are considered inoperable. The radium is inserted into the growth via the perineum, and must be applied with meticulous care and with an exact knowledge of the effect of irradiation upon the normal tissues of the body. Therefore, so long as the disease has not spread beyond the capsule of the prostate, removal of the growth by operation is the correct procedure; but when it has infiltrated the surrounding tissues, e.g. the base of the bladder

and the vesiculæ seminales, the use of radium is indicated. Retention of urine is a not uncommon feature in extensive carcinoma of the prostate, and in those cases where removal of the growth by operation is contra-indicated, it will be found necessary to make a permanent opening in the bladder above the pubes. The method of suprapubic drainage, as introduced by one of the authors, consists in the insertion of the self-retaining tube invented by M. De Pezzer. The operation is a simple one, and can be performed without difficulty by a practitioner in a cottage hospital, or other convenient place. The steps of the operation are as follows :

The bladder should be distended with at least 16 ounces of boric lotion at body temperature. An incision of about three-quarters of an inch is made just above the pubes. The sheath of the rectus is then cut ; with the tip of the finger the fibres are separated and the bladder wall felt beneath. A trocar and cannula, the latter fitting a No 28 De Pezzer tube, are then plunged through the bladder wall. The trocar is removed ; the tube, guided by a stilette, is passed through the cannula into the bladder. The cannula is withdrawn and then the stilette, leaving the tube in the bladder. The end of the tube is mushroom-shaped and plugs the orifice securely, automatically flattening out with the rise of urine ; moreover, the hole in the bladder is exactly equal to the size of the tube, so that leakage is impossible.

After the wound has healed (usually about forty-eight hours later), a wooden stopper is inserted into the distal end of the tube, and the patient is able to walk about in comfort without fear of wetting his clothes. A rubber garter round the thigh holds the tube in position. So simple and practical is this device that when the patient desires to micturate

he can slip the tube from under the garter and remove the wooden stopper, thus relieving Nature by the artificial means as easily as by the natural.

In order to keep the urine sweet and the tube free from mucus and phosphates, the patient should be provided with a glass syringe and instructed to wash out the bladder morning and evening with potassium permanganate 1 in 8,000. Acid sodium phosphate 15 to 30 grains four times daily should be given to keep the urine acid.

The tube should be removed about once a month and replaced by a new one. This is easily done with a stilette, which straightens out the proximal end, so that it can be inserted into the bladder.

Patients find the utmost relief from this method of bladder drainage; they carry on their work and experience no discomfort or inconvenience apart from washing out their bladders.

The operation is also successfully used for cases requiring suprapubic drainage of the bladder owing to deficient excretion of urea, prior to prostatectomy. As local anæsthesia is usually sufficient, the patient undergoes a minimum of shock. Well does the urologist know that the shock of a preliminary cystotomy in cases of threatened renal failure in consequence of an enlargement of the prostate will often cause death. So simple a procedure as the insertion of the De Pezzer tube reduces the shock, and, should the kidneys recover their full function, it permits the removal of the prostate without the difficulty caused by the scarring of the abdominal wall.

DIAGNOSIS AND TREATMENT OF CALCULI OF THE PROSTATE GLAND: see chapter on calculi of the urinary tract (page 116).

CHAPTER XVI

STRICTURE OF THE URETHRA

IN the male, narrowing of the lumen of the urethra is usually due to trauma or inflammation; occasionally it is congenital in origin. Stricture of the urethra seldom occurs in the female.

The severity of the injury varies from complete rupture of the urethra to a slight tearing of the mucous membrane. Immediately after the accident, the patient is seized with pain, and, attempting to micturate, passes a little pure blood. Whether the rupture is complete or partial, fibrous tissue forms, and is ultimately followed by a variable degree of stricture. In the female injury to the urethra is sometimes the direct consequence of labour.

Gonococcal inflammation is responsible for the highest percentage of strictures; tuberculous urethritis and intra-urethral chancre are other causes. The history of a blow on the perineum or penis followed at a later date by increasing strain and difficulty on micturition suggests stricture. Other characteristic signs are changes in the urinary stream: pain on micturition is not usual.

Urethroscopy will confirm the diagnosis except in an elderly patient, when such an examination may give a negative result. The obstruction is then probably due to prostatic disease. An advantage of urethroscopy is the elimination of spasm of the compressor urethræ, a condition which is found in certain nervous individuals, and causes difficulty of micturition and even retention of urine. Malignant disease of the

urethra in its early stages exhibits the typical symptoms of stricture, and can only be diagnosed by urethroscopy.

TREATMENT.—If diagnosed early, urethral stricture of inflammatory origin should never need operative interference. Treatment must be undertaken with bougies and urethral sounds so as to restore as far as possible the normal passage of the urethra. For successful handling gentleness is a *sine quâ non*, otherwise repeated damage to the mucous membrane will cause increased scarring and therefore tighter stricture. Excessive bleeding, extravasation of urine, and fatal syncope are other complications which may result from rough manipulation with urethral instruments. Finally, cystitis may result from the neglect of aseptic precautions.

The treatment of a ruptured urethra must be prompt. If a catheter can be passed it should remain tied in for a week. Should this be impossible a suprapubic cystotomy must be performed, and subsequently external urethrotomy with excision of the lacerated portions of the urethra.

Early Stricture.

An effective method of treating an early stricture is detailed as follows :

In order to ascertain the degree of contraction, a graduated whip bougie should be passed. When resistance is offered to the passage of this instrument the position should be noted and the bougie withdrawn. A second bougie, the exact size of that part of the whip which is gripped by the stricture, must then be passed. This suffices for the first treatment. A week later two bougies should be passed, one the same size as at the previous treatment, the second a size larger. At intervals of seven days this should be continued,

gradually increasing the size of the bougies until No. 22 French size can be passed. From this time onwards metal sounds are substituted at intervals of a fortnight, two only at each treatment, until the urethra will admit a full-sized sound. The intervals should then be gradually lengthened until treatment takes place every six months.

Provided that the patient leads a healthy life and reduces the amount of alcohol he takes to a minimum, no complication need be feared; but it must be impressed upon him that the passage of a full-sized instrument every six months is a necessary precaution against further contraction of the stricture.

Neglected Stricture.

Such a condition is often complicated by numerous false passages, occasioned by careless instrumentation and by ulceration behind the stricture. To those accustomed to handle urethral instruments a stricture is rarely impassable, although much patience may be necessary to pass even a filiform bougie. Retention of urine is often produced by a high degree of contraction.

TREATMENT.—The patient should rest in bed with the filiform bougie tied in: urine can then pass alongside it. Twenty-four hours later an attempt should be made to pass a larger instrument. If this operation is successful, the patient can get up, and after three days another and slightly larger instrument should be passed. The initial passage of a filiform bougie is facilitated if a number of filiforms are first inserted into the false passages.

Thereafter the patient should be treated on the lines indicated previously for early stricture.

When a filiform bougie is the only instrument which can be passed, and further dilatation of the lumen seems impossible, the operation of internal urethrotomy is

recommended. The stricture is cut from within the urethra, and provided that the post-operative treatment is carefully regulated the subsequent results are satisfactory.

In cases where no instrument can be passed, external urethrotomy should be performed. If the facilities for this operation are not immediately available and retention of urine is complete, the patient should be relieved temporarily by suprapubic cystotomy.

POST-OPERATIVE TREATMENT.—After *internal urethrotomy* a catheter should be tied in the urethra for three days. Hæmorrhage is prevented by the pressure of the instrument against the cut surface. The bladder should be washed out twice daily with a weak antiseptic, such as potassium permanganate 1 in 10,000.

On the fourth day the catheter is removed; on the fifth, if there is no rise of temperature, a bath should be given. At the end of a week the patient can leave the nursing home. For one month from the date of operation no further treatment is required, but two to three sounds should be passed at the termination of this period.

A considerable percentage of permanent cures are effected, but the passage of a large sound every six months is a wise precaution.

After *external urethrotomy*, a catheter must be tied in until the wound of the perineum has healed, after which the same post-operative treatment as for internal urethrotomy is required.

STERILISATION OF URETHRAL INSTRUMENTS.

All instruments should be boiled and placed in an antiseptic solution, such as carbolic acid 1 in 80 or formalin 1%. It is most important to keep all urethral instruments dry when not in use, both for the purpose of preservation and asepsis. A satisfactory way to

keep bougies and catheters always sterile and ready for use in a glass tube, at the open end of which is a metal perforated stopper containing formalin powder. Thus the contents of the tube are surrounded by formalin vapour.

Extravasation of Urine.

When this condition is not the result of trauma to the urinary organs, it is a complication of urethral ulceration associated with stricture or peri urethritis. It may be the practitioner is required to see a patient who has been seized with a rigor when in apparent good health, and who complains of no subjective symptoms of urinary disease.

Perhaps the patient is unobservant, and has failed to notice a gradual narrowing of the urinary stream, and although closely questioned will not assist in discovering whether urethral stricture be not the cause of the sudden fever. If a primary focus in any other part of the body and such a disease as malaria can be excluded, it is wise to examine the urethra as the possible site of the infective process. Should a stricture be discovered, it is reasonable to suppose that either ulceration has taken place behind it allowing extravasation of urine, or an ascending infection of the kidneys is manifesting itself. A rigor, tenderness on pressure of the perineum, and slight œdema of the skin, will be the signs and symptoms of commencing extravasation.

Treatment must be prompt. Under general anæsthesia the stricture is fully dilated and an incision made in the perineum so as to expose the area of extravasation. All necrosing tissue should be excised and the wound packed with gauze. When forty-eight hours have elapsed, and the patient has recovered from shock, treatment on the principle adopted in cases of septic cellulitis in other parts of the body should be undertaken.

For one hour every day the patient is lifted into a hip bath containing water at body temperature. If the case is very septic a few drops of sanitas are added. While soaking in the bath the wound should be freely exposed, all dressings being removed. On returning to bed the perineal wound must be repacked.

Chronic extravasation with multiple fistulæ is treated differently. Before attempting to deal with the local condition the urine must be drained away through a tube inserted into the bladder above the pubes. The fistulæ in the perineum are excised, and at a later date the recommendations for the treatment of stricture carried out. The urine should be drained suprapubically until the wounds in the perineum have healed.

CHAPTER XVII

STONE IN THE URINARY TRACT

A STONE may form in any part of the urinary tract, and unless its composition consist of pure uric acid will give a shadow to the X-rays. Skiagraphy, therefore, must be an essential part of the examination in all cases where a calculus is suspected. Cystoscopy is equally important, for thereby a stone in the bladder or in the vesical end of the ureter can be detected. If a skiagram demonstrates a shadow in the line of the ureter further investigation is necessary to determine its cause, for a calcified gland, lying on, or adjacent to, the duct, will give a shadow to the X-rays indistinguishable from that produced by a calculus. In order to clear up this point a bougie which is opaque to the rays must be passed up the ureter, and which therefore, in a skiagram, will give the anatomical relationship between it and the shadow.

Symptoms.

The symptoms caused by stones in the urinary organs vary according to their position, their size, and the presence or absence of suppuration.

Pain.—A dull ache in the loin, difficult to distinguish from lumbago, increased by lateral movements of the trunk and violent exercise, persisting intermittently for many months, and causing no marked constitutional disturbance, is suspicious of the presence of a calculus in the substance of the kidney. As a rule there is no renal tenderness on palpation.

When, however, the stone lies in the renal pelvis,

the pain is of a colicky nature, sharp and stabbing, causing nausea and even, in some cases, vomiting. During the attack the kidney is tender on palpation, but this sign is absent in the intervals of pain.

While a stone in the ureter is stationary, pain will be absent, but as soon as forcible contraction of the ureteric muscle occurs, the patient will be seized with a colicky pain situated immediately over the stone, and thence referred along the course of the duct to the genitalia.

Appendicular and ureteric colic are so similar that one is often mistaken for the other, but the former is a more superficial pain, and is never referred to the external genitalia.

When the stone is in the bladder or the urethra, pain is referred to the tip of the penis, and in the case of calculi in the prostate gland the patient will complain of aching in the perineum.

Changes in the Urine.

Stone in the Kidney.—The changes that occur in the urine if the stone is in the cortex or silent area of the kidney, can only be recognised by microscopic examination. The urine then contains an increase in the number of crystals, phosphatic, oxalate, or uric acid, according to the chemical constitution of the calculus. If the stone is situated in the calyx or pelvis, hæmaturia is a common symptom. Pus will also be present, its amount depending upon the degree of infection.

An observant patient will sometimes draw the attention of his medical attendant to the alteration in the quantity of urine passed before and after an attack of renal colic. Previous to the onset of pain the amount of urine passed will be small, but following the attack there will be a sudden escape of urine from the pelvis of the kidney which is followed by polyuria.

The condition known as anuria or cessation of the

flow of urine occurs when both kidneys are damaged by the presence of calculi in the urinary tract.

Stone in the Ureter.—Much depends upon the size of the stone in this situation with regard to the changes in the urine.

If the stone is of such a size as to obstruct the free flow of urine, infection of the kidney takes place, and a considerable quantity of pus will be voided on micturition. After an attack of ureteric colic, hæmaturia may be a prominent sign.

On the other hand, a small stone, should it remain stationary, may give rise to no alteration in the urine.

Stone in the Bladder, Prostate or Urethra.—Pyuria and intermittent hæmaturia are the changes noted when a stone lies in the bladder or is lodged in any part of the urethra, whereas if the calculus is in the substance of the prostate gland, hæmaturia will be absent or inconspicuous.

Treatment.

Kidney.—Operative treatment is indicated in all cases of renal calculus, unilateral or bilateral, with the one exception of a single small stone lying in the cortex. The latter case should be treated on medical lines, and skiagrams taken at intervals in order to observe any change in the size or position of the calculus.

Ureter.—A large stone should always be removed by operation, but a small calculus can be left for six months in the hope that it may be passed during micturition. If at the end of this time the stone, as shown by a skiagram, has not changed its position, operative interference is advisable. Small stones lying in the vesical end of the duct can be dislodged by dilating the ureteric orifice with the aid of the operating cystoscope.

In those cases where immediate removal is not decided upon, in order to assist the stone in its passage down the

urinary tract, large quantities of fluid, such as barley water, Imperial drink and Contrexèville, must be taken.

The Bladder.—The stone should be removed by the operation of litholapaxy at the earliest possible moment, unless it is very large, lying in a diverticulum, or associated with an enlarged prostate. In such cases the stone is removed by suprapubic cystotomy.

The Prostate and Urethra.—If the stone lies in the prostate gland, the bladder must be opened above the pubes, and, with the patient in the Trendelenburg position, both gland and stones are removed at the same time.

Should the stone be in the urethra, an attempt may be made to remove it by means of crocodile forceps passed down the urethra. If this procedure fails, access to the calculus is obtained by the operation of external urethrotomy.

It is a not unusual question for a patient to ask, after a stone has been removed from some portion of his urinary tract, how the formation of another calculus can be avoided.

First, he should be warned against living in a climate where most of the body moisture escapes via the skin. In other words, concentration of urine predisposes to calculus-formation.

Secondly, vegetables containing oxalic acid, asparagus, strawberries, beetroot, etc., must be excluded from his diet.

And lastly, it is important that no alcohol be taken, and that he drinks large quantities of barley water, Contrexèville or Imperial drink. *Hard* water must also be avoided. If a cause for the formation of the stone is discovered, e.g. chronic cystitis, treatment for such must not be neglected.

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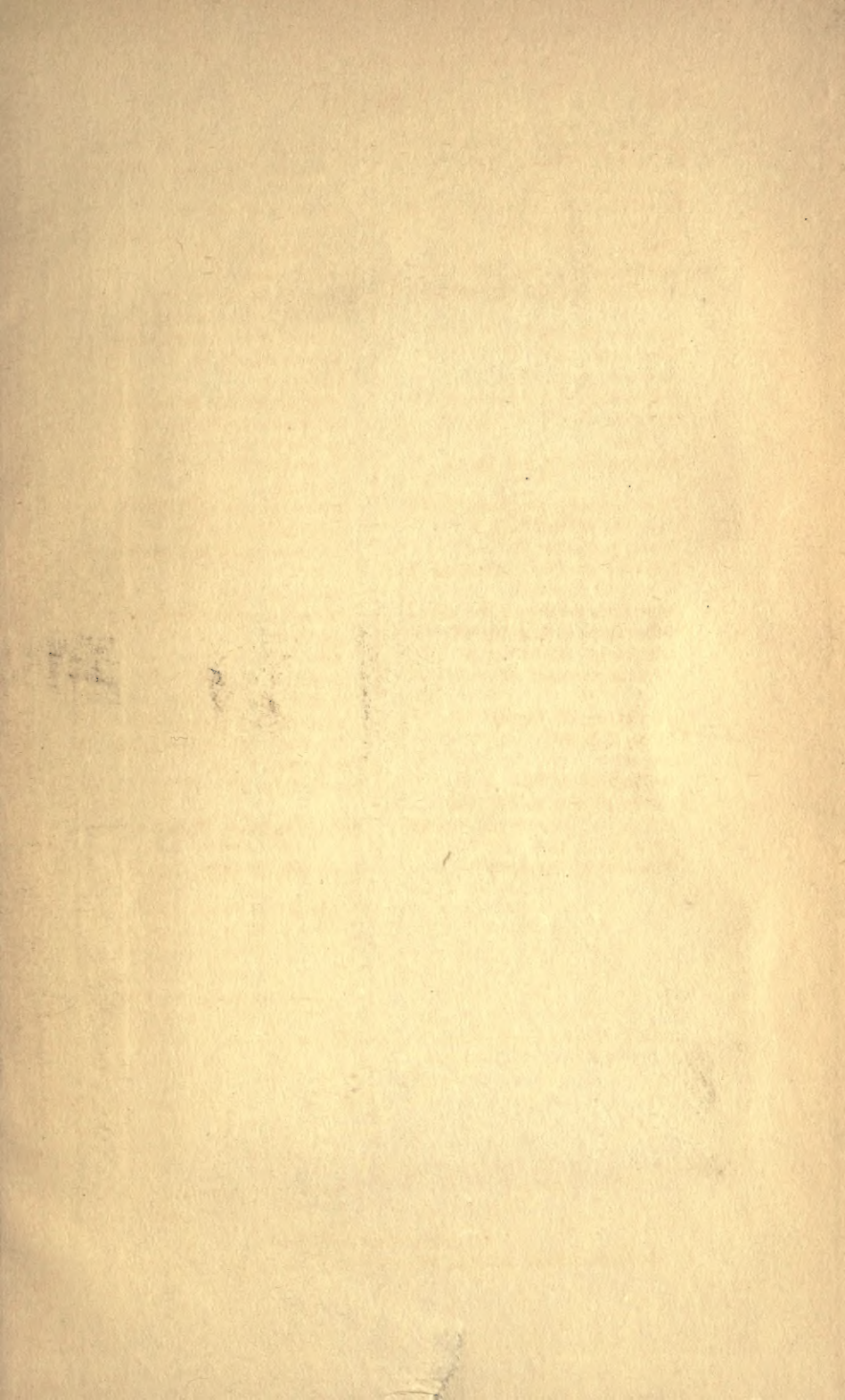
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